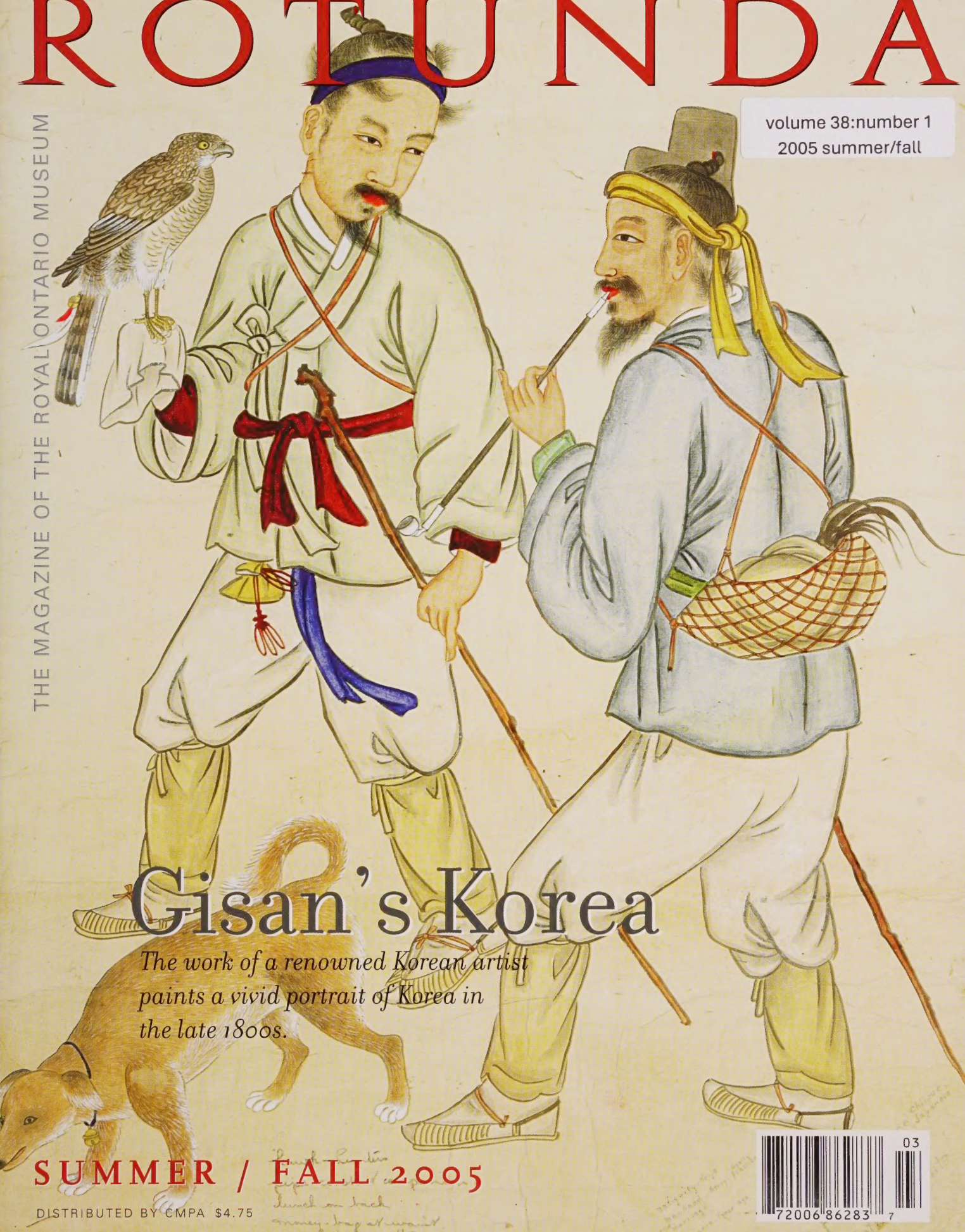
ROTUNDA

THE MAGAZINE OF THE ROYAL ONTARIO MUSEUM

volume 38:number 1
2005 summer/fall



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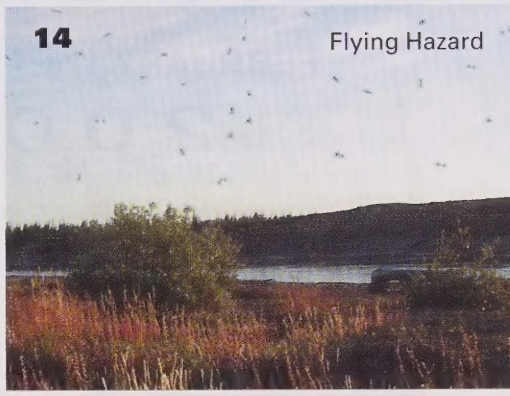

COVER: *HAWK HUNTERS*, BY KOREAN ARTIST GISAN. PHOTO BY BRIAN BOYLE, ROM / 985x5.21

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Christina Hee-Yeon Han

ROM's Department of World Cultures

CHRISTINA ("Art on a Mission") is an academic advisor for the ROM's Korea Gallery and a doctoral candidate in the University of Toronto's Department of East Asian Studies. Her Ph.D. research focuses on a comparative study of Korean and Chinese landscape tradition and literati culture.

Doug Currie

Entomology Section, ROM's Department of Natural History

DOUG ("Fly Season"), curator of entomology at the ROM, is also a cross-appointed associate professor in the Department of Zoology, University of Toronto. Doug's research focuses on the systematics and evolution of biting flies. His main interest is the black flies. Along with co-authors Peter Adler (Clemson University) and Monty Wood (Agriculture Canada), he recently completed a book entitled *The Black Flies (Simuliidae) of North America*. This nearly 1000-page treatise, co-published by Cornell University Press and the Royal Ontario Museum, was awarded the 2004 Association of American Publishers Award for Best Single-Volume Reference in the Sciences. Currently, Doug is studying the black flies of the Chukotka Peninsula in eastern Siberia.

Jacqueline R. Miller

ROM's Department of Natural History, Centre for Biodiversity and Conservation Biology

JACQUELINE ("Tiny Pavarottis") is a Ph.D. candidate in the department of Zoology, University of Toronto. Her research focus is the evolutionary history and ecology of mammalian vocal communication, using a molecular model. Employing DNA sequencing, morphological analyses, and the spectral analysis of acoustic behaviour, her research on New World mice has involved fieldwork in Texas, Mexico, Nicaragua, Costa Rica, and Panama in many different ecological habitats and under a variety of field conditions.

During her career, Jacqueline has worked on many other mammalian projects, from diversity surveys to primate conservation and ecology. She has presented her work widely, and it has been recognized with numerous scholarships and awards.

CORRECTION In the Spring 2005 issue, a story entitled "Spirit of the Plains" incorrectly stated that Sitting White Eagle lived on Sakimay Reserve. Several elders and researchers from Sakimay have since confirmed that in 1891 Sitting White Eagle transferred from Pasqua Reserve to Cowessess, the reserve adjoining Sakimay's western boundary.

Julia Matthews

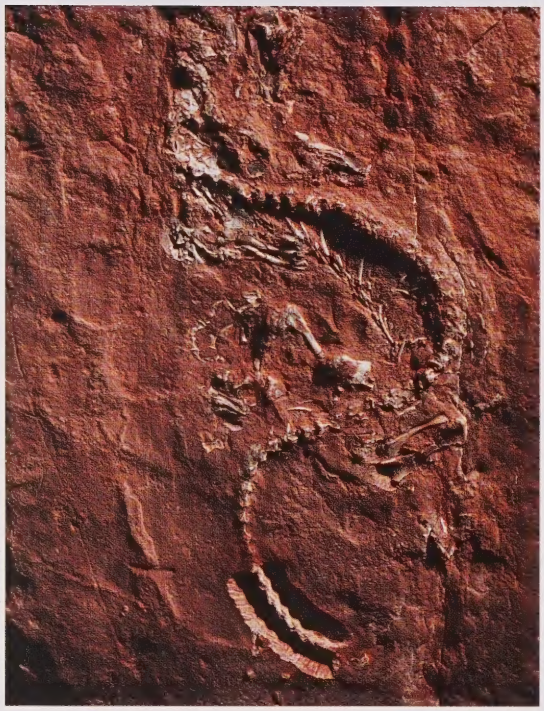
JULIA ("From the Archives"), who is retiring and writes her final column for *Rotunda* in this issue, grew up in Ottawa, where her first solo bus ride was to the National Museum. Her interest in museums was nurtured by the National Museum's equivalent to our Saturday Morning Club. She went on to work the Saturday reception desk at the National Gallery, where the highlight was a visit from Haile Selassie.

At Carleton University, she studied with John Porter as he was writing his epic tome *The Vertical Mosaic*. Julia taught English for five years in Ottawa and in London, England, before heading off to library school. Over the next decade she worked at the OISE Library, raised two children, and completed two more degrees. She also worked on numerous projects for TVO, Centennial College, the National Youth Orchestra, and the Council of Ontario Universities, before arriving at the ROM in 1983, where she has served as head librarian.

Over the past two decades, Julia has been a mentor to numerous Museum Studies students and been involved in a wide range of ROM activities, including starting the ROM's Web site, mounting exhibitions in the Library Gallery, and participating in public programs. Her most famous role was that of Mrs. Currelly at the launch of the Currelly Society, and she continues to be a fount of information relating to ROM archival history. The Ontario Museums Association has recognized Julia's work with an award of merit.

We wish Julia much success in the next phase of her career.

EXPLORA



BRIAN BOYLE, ROM / ROM 55402

Island Find

New species of early reptile discovered

THIS NEARLY COMPLETE and articulated skeleton was recently acquired, dug from Permian strata about 250 million years old in Prince Edward Island by Michael Arsenault. Although not yet fully prepared, enough of the fossil has been exposed to show that it probably represents a new species of one of the earliest known kinds of reptile. The somewhat crushed head is at the top, and the tail is at the bottom. It is the most complete example of a late Paleozoic tetrapod (four-footed creature) ever to be found in Canada. The only other known specimen was also from Prince Edward Island, and it consisted of only part of a skull of a larger and different kind of reptile. It was sold to the Philadelphia Academy of Natural Sciences, a sad loss to Canadian paleontology. This happened in 1854, however, before Canada was even a country. The new specimen was purchased from the Arsenault family with a generous grant from the Louise Hawley Stone Charitable Trust, as well as donations from ROM Members Cynthea Cooch and Helen Manning. The Arsenault family is using the money to help put Michael through university, a fitting tribute to his hard work in recovering the specimen.

—Kevin Seymour

BRIAN BOYLE, ROM / M49957

Rediscovering

William Smith's great geological map o

IF YOU HAVE read the award-winning book *The Map That Changed the World* by Simon Winchester, you will already know something of canal-builder/civil engineer William Smith's heroic struggle during the early 19th century to assemble his great geological map of England. That may seem old hat today, when geological maps are used routinely, but almost 200 years ago it represented a revolution in thought and practice. This map not only charted where sedimentary strata of different ages occurred, but it also showed that mineral resources such as coal and limestone were not distributed randomly, and could be searched for intelligently and rationally—a most important concept during the Industrial Revolution of 18th- and 19th-century England.

Did you know that one of Smith's original hand-coloured maps is at the ROM? I rediscovered it when ROM mineralogist Dr. Robert Gait asked me to look at an "old geological map" in Mineralogy's vault. It had been found

T I O N S

ROM Treasure

ngland and Wales with part of Scotland

wedged behind a radiator in the Geology Department years before.

I found myself looking at an original William Smith map, number 56a, published and hand-coloured about 1817. Some research showed that it was purchased in 1914 by A. P. Coleman, then the director of the Royal Ontario Museum of Geology and one of Toronto's important geologists; subsequently, the map probably remained unnoticed for decades, although it surfaced long enough in the 1960s to be accessioned into the Geology Department's map collection.

The map—with a publication size of about 6 feet 2 inches wide by 8 feet 9 inches high—has now been catalogued, evaluated, and conserved, and is safely back in Mineralogy's vault in its own, new protective box. These steps, taken 90 years after Dr. Coleman had the foresight to acquire this exceedingly rare and valuable treasure for the ROM, will help to assure that it will not be "lost" again.

—Peter von Bitter

BRIAN BOYLE, ROM / 2005.43.1.1

History Tied in a Bow

A piece of Netsilingmiut hunting equipment speaks volumes

IN 1879, 34 YEARS AFTER the disappearance of Sir John Franklin's expedition in search of the Northwest Passage, Lieutenant Frederick Schwatka commanded a search expedition to find written records that would detail Franklin's fate. He discovered skeletons and relics, but written records remained forever elusive. From Hudson Bay, Schwatka travelled by dog sledge to King William Island, covering 5030 kilometres (more than 3100 miles.) During the expedition, Schwatka collected Inuit artifacts, including a bow, which is now part of the ROM's collection thanks to the generosity of the Museum's Friends of the Canadian Collections.

Acquired from the Netsilingmiut of King William Island, the bow's two lengths of muskox horn are spliced together and secured with three copper rivets. Antler limbs, lengthening the bow stave, are attached with bone pegs and lashings of braided caribou sinew. The bow string, too, is of plaited sinew and the stave is strengthened with a braided sinew backing.

The bow is a touchstone to a history of events beyond the throw of its immediate shadow: it represents stories of Inuit relations with the animal world, of traditions passed down through generations, and of Franklin's misfortune, which still captures our imagination today. Most intriguing though, Schwatka reported that the Inuit used "copper stripped from Sir John Franklin's ships to rivet their bows together." Is it possible that this bow with its three copper rivets possesses the spirit of Sir John Franklin himself?

—Kenneth R. Lister

ROTUNDA

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Wolf at the Door

Many friends in both Toronto and Mongolia assisted with the complex task of certifying a wolf pelt for donation to the ROM.

BRIAN BOYLE, ROM

Wolf pelt at the ROM.

JUDITH EGER

When textile enthusiast Michael Gervers asked me if I'd be interested in having a Mongolian wolf pelt donated, I was eager to accept. The ROM has a small collection of wolf pelts from Ontario, Nunavut, and the Northwest Territories collected from the 1920s to 1940s, but nothing from an exotic place such as Mongolia. Artists refer to the pelts for illustrations, scientists study them for taxonomic and genetic research on wolves, and ROM staff use them for teaching.

In July 2002, Michael—who is professor of History and director of Central and Inner Asia Studies at the University of Toronto, and departmental associate in the Textile Section of the ROM's Department of World Cultures—met visitors from Mongolia. Batima and her young daughter, Janar, had come to Toronto sponsored by a local church group so that Janar could have her heart repaired at The Hospital for Sick Children. The operation was a success, and after Janar recovered, Otto Farkas of World Vision in Ottawa, who worked for a number of years in Mongolia's capital, Ulaanbaatar, asked Michael to arrange for them to tour the ROM.

They arrived at the Museum with their interpreter, Naranchimeg, and Michael escorted them on a personal tour of the galleries. Some weeks later, Michael flew to Ulaanbaatar to attend an international conference on Mongolian studies. Afterwards, he met up with Naranchimeg and the two

TOP TO BOTTOM: NARANCHIMEG, MICHAEL GERVERS, MICHAEL GERVERS

Top: Michael and Sultanmurat inside the *ger* (a circular tent of felt or skins on a collapsible framework) at the winter pasture at Ich Möst. A wolf pelt covers their shoulders. **Middle:** Family members from right to left: Asgar, Batima (mother), Janar (daughter), two younger sons, and Sultanmurat at their winter pasture. **Bottom:** Ox-cart transport with *ger* in background.

drove north to visit Batima, her husband, Telee, her son, Asgar, and Janar, at their summer pasture at Elsteen Uul, a few kilometres east of the capital near Nalaih in Tov province. From there, Telee conveyed the group by ox-cart across the River Tuul to visit Batima's parents at the family's winter pasture at Ich Möst, a beautiful site in the lee of a mountain.

Batima's parents, Sultanmurat and Zina, generously received Naranchimeg and Michael, serving milk tea followed by *airak* (fermented mare's milk), and a clear alcohol distilled from milk, together with dried curd, sliced sausage and pickles, milk skim (semi-dried cream from the top of the milk), butter, and several types of bland bread. Towards the end of the visit, Sultanmurat produced a wolf pelt and presented it to Michael in recognition of his visit to Mongolia and as a thank you for showing Batima and Janar around the ROM.

Telee shot the wolf the previous winter. The family skinned, cleaned, and cured the pelt themselves. During subsequent travels in northern Mongolia, Michael encountered several nomadic camps where similar pelts were being aired in the wind.

In the folklore of Inner Asia, the wolf is seen as an ancestral figure and a symbol of individual or military greatness. Among the Mongols, however, the wolf is also regarded as a predator in constant conflict with the herding peoples; it attacks their sheep and other domestic livestock. Religious observances are performed and amulets are worn even today in the belief that they will protect people and livestock from the ravages of the wolf. Author Ruth I. Meserve, a professor in the De-

partment of Central Eurasian Studies, Indiana University, notes in a paper "How to get rid of wolves" that offerings are made to the fire god to prevent wolves and thieves from coming near, and that there are ceremonies that provide protection from wolves.

But there was an impediment to the ROM's accepting Sultanmurat's wolf pelt—CITES, the Convention on International Trade of Endangered Species to which both Canada and Mongolia are signatories. Wolves were once found throughout the northern hemisphere, but human efforts have deliberately and radically reduced their populations and distribution. For this reason, the grey wolf is listed by CITES on Appendix II, meaning that it is endangered in parts of the world and that to import the pelt to Canada, Michael would have to obtain an export permit from Mongolia. Without the Web, such a task would have been impossible. But thanks to help from Ambassador Batsukh of the Mongolian Embassy in Ottawa, who directed Michael to the Ministry of Nature and Environment, and with assistance from the many "Friends for the donation of the Mongolian wolf pelt," Michael was able to obtain the export permit.

Thanks to the following friends for their help—Otto Farkas and Amelia Merrick of World Vision who had connections in Mongolia; Batkhishig of the United Nations Development Program, who had connections to government departments in Ulaanbaatar; Ariunaa, the interpreter I met at the ROM in the summer of 2004, and chief organizer of the quest for the permit in Ulaanbaatar; Ariunaa's brother who journeyed north from Ulaanbaatar to pick up the pelt; Ariunaa's husband, Javkhlan Norgim, who took the pelt to the CITES authorities; and finally Michael Gervers himself who kept his finger on the pulse of one of the more complex donations to the ROM's mammal collection.

Judith Eger is senior curator of Mammalogy in the ROM's Department of Natural History.

COMING IN THE WINTER 2005 / 2006 ISSUE

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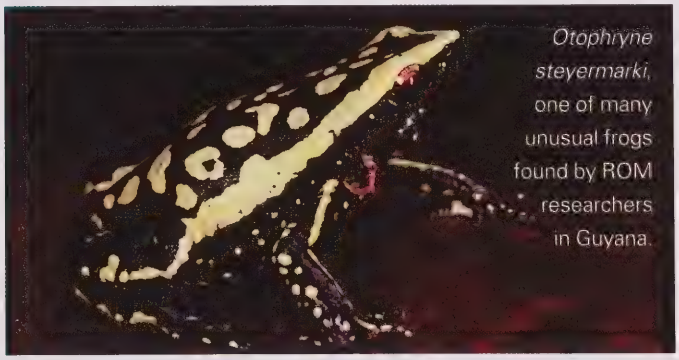
A Tale of Two Tepuis

ROM researchers find that isolated mountains in Guyana's rainforest are hotspots of biodiversity.



Otophryne steyermarki, one of many unusual frogs found by ROM researchers in Guyana.

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The Logic of Love

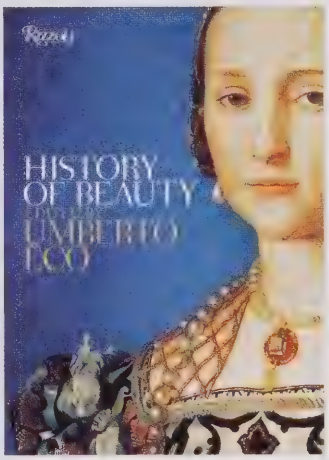
FEATURE REVIEW

History of Beauty

Umberto Eco, ed. (Rizzoli, Cloth: $55)

It must be stated up front that the present volume is an adaptation or the book version of a CD-ROM titled *Bellezza: Storia di un'idea dell'occidente,* edited by Umberto Eco and produced by Motta On Line in 2002. This information (from the book's copyright page) is important in that it explains the intended scope of the work. Readers will be quick to observe that the book might more accurately have been titled *Beauty: A Western Perspective.* The textual and pictorial items cited are in fact almost exclusively European. Having established then the geographical circumscription, we are not looking to it to be global in its analyses and iconography.

The work proceeds textually from ancient Greece to the end of the 20th century, and pictorially from the ultra-pneumatic Venus of Willendorf (30th millennium BC) to svelte Italian film star Monica Bellucci (1997). The authors, Eco and Girolamo de Michele, explore what appear to be changing, if not evolving, concepts of beauty as expressed primarily through art, but they also cite philosophical and literary sources. They assert that beauty is relative rather than absolute. Obviously there are those who would challenge the tenability of that idea, arguing that in the case of the human form, for instance, male and female "ideals" are conceivable, ideals that would transcend time and geography, eliciting consistent positive aesthetic response. This is not to overlook the dramatic variations to be found in such polarities as well-fed Rubenesques and starved supermodels, but revealingly, nearly all of the icons featured in the book's gallery of Venuses and Adonises are in fact mesomorphs, so perhaps some conclusions about absolutes may be drawn after all, at least within the context of this two-millennia slice of time. Although the focus is emphatically on the human form, the discussion touches also on the beauty of abstract concepts, architecture, and technology.



The pictorial dimension of the work is overwhelmingly art based. The authors are especially insightful in their discourse on the Middle Ages, often misrepresented as the "Dark Ages" and here revealed as an age of light and colour. All in all, the material pertaining to the second half, and especially the last quarter, of the 20th century is scant by comparison with the sections that precede it. The content of the gallery of icons is sometimes surprising, especially in its omissions. Michelangelo's *David,* surely the most celebrated male nude in the western hemisphere, is conspicuously absent among the nude Adonises. The gallery of 20th-century Venuses includes Hayworth, Monroe, Bardot, and Twiggy(!) but not Raquel Welch or Sophia Loren. Botticelli's Venus rises fully formed from the sea *(The Birth of Venus,* c. 1482) but not so bikini-clad Ursula Andress (*Dr. No,* 1960) or Halle Berry (*Die Another Day,* 2002).

Any new work by Eco is to be heralded and this one does not disappoint. The book is also beautifully designed and made. A thoughtful and sophisticated study, an intelligent exploration of sensual perception.

The Offer of the Heart, scene from the *Romance of Alexander,* MS. Bodl. 264, Bruges, atelier of Jehan de Grise, 1338–1344. Oxford, Bodleian Library.

Glen Ellis is head of Publications, Royal Ontario Museum. Marianna Ricciuto is a Royal Ontario Museum intern.

REVIEWED BY GLEN ELLIS AND MARIANNA RICCIUTO

Book Awards Announced

THREE ROYAL ONTARIO Museum publications have been honoured this year with prestigious awards. *The ROM Field Guide to Wildflowers of Ontario* (ROM/ M&S) by Dr. Timothy Dickinson, Debra Metsger, Jenny Bull, and Richard Dickinson, won the Canadian Museums Association award for outstanding achievement in Canadian museum publishing. *Journey to the Ice Age: Discovering an Ancient World* (UBC Press/ ROM), by Dr. Peter Storck, won the Canadian Historical Association award for best book about Ontario history. It also received a commemorative plaque from the Canadian Archaeological Association and an Alcuin design award. *The Black Flies of North America* (Cornell/ROM), by Dr. Douglas Currie and colleagues Dr. Peter H. Adler and Dr. Monty Wood, won the Association of American Publishers Award for Best Single-Volume Reference in the Sciences. The Royal Ontario Museum congratulates the authors, editors, designers, and publishers of these distinguished works. Royal Ontario Museum Publications wishes to thank the Louise Hawley Stone Charitable Trust within the ROM Foundation for its generous support of these books.

High Style: Masterworks from the Bernard and Sylvia Ostry Collection in the Royal Ontario Museum

Alastair Duncan, with contributions by Ross Fox, Peter Kaellgren, Robert Little, Brian Musselwhite
(ROM, Cloth: $39.95)

THE FABULOUS Ostry collection in the Royal Ontario Museum includes silverware, furniture, art glass, light fixtures, and sculpture from the Arts & Crafts period, Art Nouveau, and Art Déco, with emphasis on the latter. This volume selects the *crème de la crème* of the collection, the pieces that represent the pinnacle of achievement in their fields, pieces that can truly be called "high style." Through illuminative text and stunning photography, *High Style* showcases a stellar collection. A tribute to the vision and generosity of ROM patrons Bernard and Sylvia Ostry.
Available October 2005

Vase , Camille Faure (1872–1956), Limoges, France, Probably late 1920s. Enamel on copper with silvered-copper collar and base.

ROTUNDA

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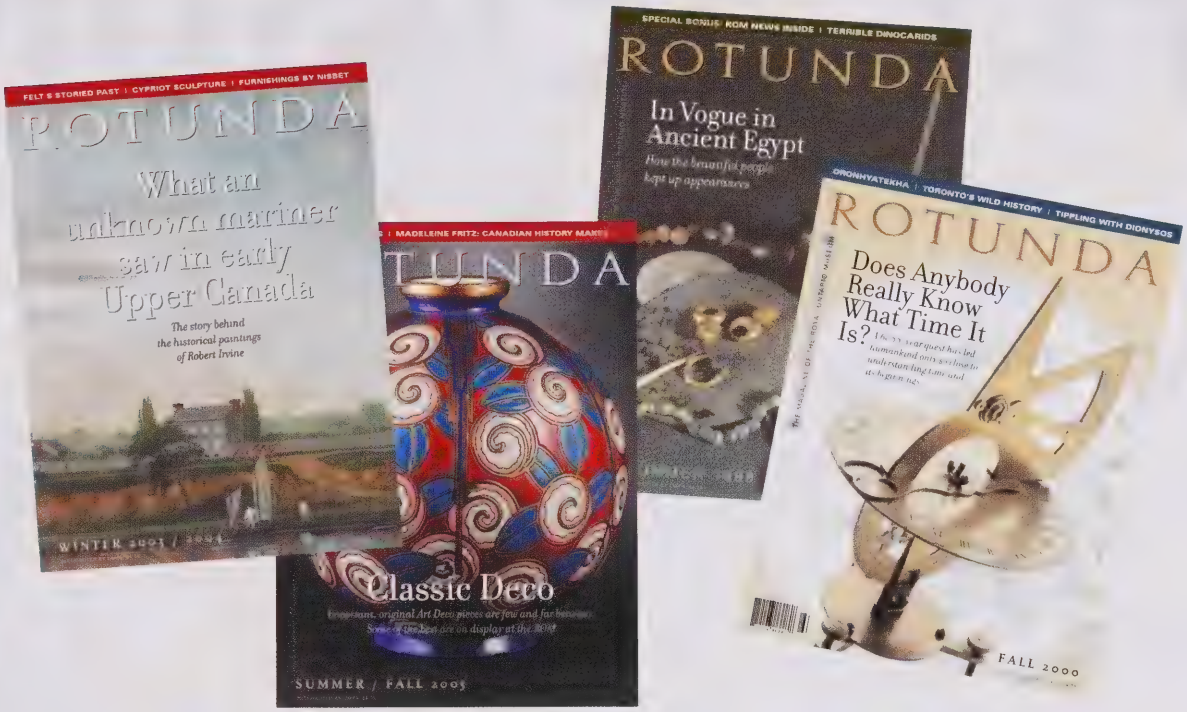

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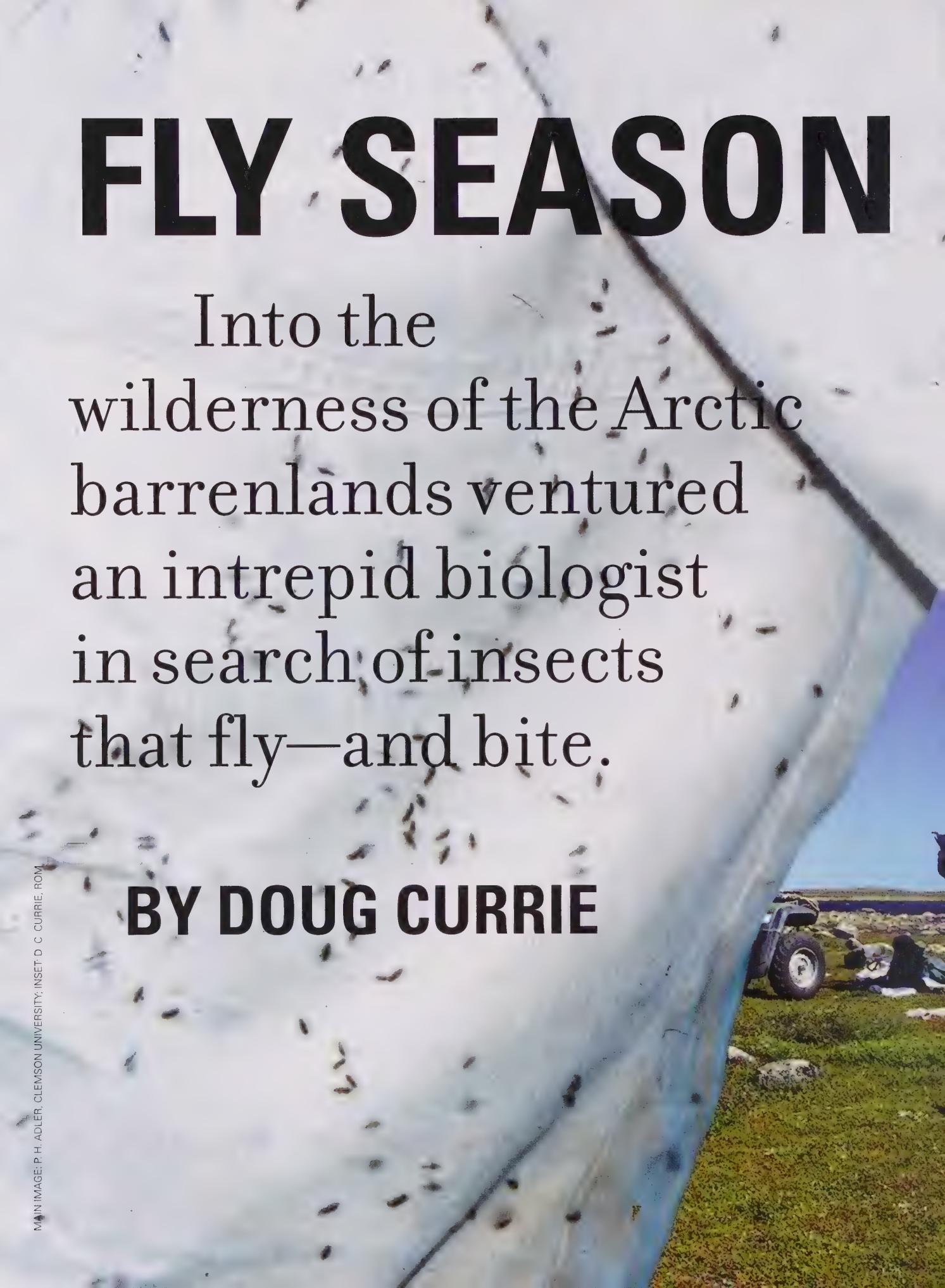
FLY SEASON

Into the wilderness of the Arctic barrenlands ventured an intrepid biologist in search of insects that fly—and bite.

BY DOUG CURRIE



MAIN IMAGE: P. H. ADLER, CLEMSON UNIVERSITY; INSET: D. C. CURRIE, ROM

IT'S 6:30 IN THE MORNING and I can't muster the energy to leave the warmth of my sleeping bag. We're three days into a four-week canoe trip down the wild and remote Horton River in the Northwest Territories, and the relentless thudding against my tent signals that breakfast will be delayed on account of rain. But as I settle back into my bag the unmistakable crackling sound of a campfire penetrates through the drumming on the roof. How did our guide manage to spark such a roaring fire in this downpour? Am I delirious from the exertions of the previous day's paddle?

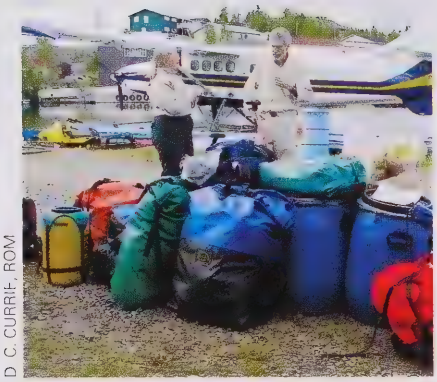
Poking my head through the vestibule I see that everyone else in camp has already rallied, with mugs of steaming coffee in one hand and the other in a constant waving motion about their heads. In an instant it hits me: the thudding I hear is not rain, but the sound of thousands of hungry black flies seeking their breakfasts. Retreating back into the safety of my tent I wonder whether I can endure another three-and-a-half weeks of this Hell on Earth.

Ironically, the pestilence outside is the very reason I ventured into these barrenlands in the first place. Few organisms are as strongly associated with the North as black flies are. I am here to research the area because until recently, the barrenlands—a treeless landscape extending as an enormous triangle from the Mackenzie River delta to Hudson Bay—have been among the areas of North America least known for their bloodsucking fauna.

Not since the federally sponsored Northern Insect Survey of the late 1940s and early 1950s has there been a concerted program to document the insect fauna of northern Canada. With this half-century of neglect in mind, I—along with Donna Giberson of the University of Prince Edward Island and Peter Adler of Clemson University in Clemson, South Carolina—resolved to embark on a multi-year program to inspire a new era of barrengrounds research. We were motivated by our conviction that current estimates of arctic insect diversity are egregiously underestimated. And furthermore, to conduct modern scientific studies, such as chromosome analysis and DNA sequencing, freshly collected material would be needed.

Donna is an ecologist with a special affinity for the three most prominent groups of aquatic insects: mayflies, stoneflies, and caddisflies. Peter and I specialize in biting flies, but of these it is black flies for which we share an inordinate fondness. Together, we conducted a series of three expeditions into the barrenlands of Canada between 2000 and 2004, accompanied variously by outfitters, guides, and biologists specializing in other groups of insects. Our plan was to update the missing data on barrenlands insects.

The barrenlands is by far the largest wilderness area in North America. With more than twice the land area of Alberta, the sheer vastness of the barrens conspires with the



D. C. CURRIE, ROM

D. C. CURRIE, ROM

D. C. CURRIE, ROM

Opening spread, main image: Covered in black flies along the Horton River. Inset: Donna Giberson taking notes near Arviat, Nunavut. This page, top left: Loading gear in Yellowknife for the Thelon River expedition. Top right: The azure waters of the Hanbury River near its confluence with the Thelon River, Northwest Territories — the starting point of the 2002 barrenlands expedition. Bottom: Caribou along the upper Horton River, Northwest Territories.

dearth of communities and roads to frustrate even the most committed collecting efforts. Consult any map of Nunavut or the Northwest Territories and you will be struck by the almost complete absence of roads. To enter the heart of the barrens one must be prepared to charter an aircraft equipped with pontoons or tundra tires. Although bush planes are renowned for their ability to fly into remote and difficult-to-access territory, they are also extraordinarily expensive to hire (we paid $12,000 for the Horton trip in 2000) and it was beyond our means to retain their services for more than a couple of flights per summer. And so, to avoid being stranded in a single area, we decided to adopt the ways of early barrenlands explorers and travel by river.

In 2000 we followed in the footsteps of the early 1900s Arctic explorer Canadian Vilhjalmur Stefansson by canoeing the 700-kilometre (434-mile) course of the Horton River, from Horton Lake to the Beaufort Sea. The route, which cuts through the northwestern corner of the barrens, provided a convenient, though strenuous, south-to-north transect from the swampy, coniferous subarctic forests called taiga north of Great Bear Lake to the tundra fringing the Arctic coast.

For our four-week expedition, we jammed nearly 450 kilograms (1000 pounds) of food and gear, including three canoes, into a Twin Otter for the hour-and-a-half flight from Norman Wells to Horton Lake. Because there are no settlements along the Horton, we had to carry all our food and supplies on the inward-bound trip. A month later, low on supplies and laden with samples, we were retrieved from a forlorn gravel bar on the Horton River delta, with one eye scanning the coast for polar bears.

In 2002 we spent three weeks retracing part of the route taken by the legendary and eccentric 1920s adventurer John Hornby by paddling a 300-kilometre (185-mile) reach of the Thelon River between Hanbury River and Beverly Lake. This section of the river cuts through the heart of the Thelon Wildlife Sanctuary, one of the largest and most remote protected areas in the world.

It is also home to the Thelon Oasis, a dense tract of forest that lines the river valley for about 100 kilometres (60 miles) of its length. This narrow thread of black spruce flourishes hundreds of kilometres north of the treeline, supporting a rich network of plants and animals more typically found in forests to the south.

Sadly, the area was not as hospitable to John Hornby and his two young travelling companions, Edgar Christian and Harold Adlard. All three starved to death in the spring of 1927 following an ill-conceived attempt to overwinter in the Thelon Oasis. We found their simply marked graves (Christian, the last to perish, was buried by an RCMP detachment a year or so after his death) alongside the ruins of a roughly hewn cabin—a grim monument to the unforgiving nature of the barrenlands winter.

Our third and final foray into the barrenlands, in 2003, took us farther east into Nunavut. The reduced flow in the area's lowland rivers and the incessant easterly headwinds rendered canoe travel all but impossible. Instead we visited Arctic communities serviced by regularly scheduled flights. The hamlet of Baker Lake in Nunavut gave us access to the geographical centre of Canada during our three-week trip, while visits to Rankin Inlet and Arviat yielded collections from two different regions along Hudson Bay's western shore.

We engaged local hunters and guides to take us on daily trips onto the land. Four-wheeled ATVs and motorboats transported us to distant collecting sites, and we gained valuable insights from the Inuit's traditional knowledge of the barrenlands flora and fauna.

Before we began our surveys, only 22 species of black flies were known from all of Arctic Canada between the Mackenzie River and Hudson Bay. Today, that number stands at 43, including two European species never before discovered in North America, and another two species new to science. This represents about 17 percent of the 255 black fly species known from Canada and the United States. Although we nearly doubled the species count for the barrenlands, the number is small compared to the black fly faunas of Alaska and the Yukon Territory (76 species) and Ontario (65 species). We knew the numbers this far north would be lower than in the rest of Canada, but found a richer variety of species than expected.

Black flies, mosquitoes, and other biters such as tabanids and no-see-ums are conspicuous and abundant constituents of the arctic biota

We found that the distribution of black flies is far from uniform across the barrenlands. We also noted differences within each of the three collecting areas. For example, although approximately equal numbers of species were encountered during the Horton and Thelon river expeditions, only about half of them (17 species) were common to both drainages.

This difference probably means that there were two different source areas for the black flies that repopulated northern Canada following deglaciation. As little as 10,000 years ago, the barrenlands were beset with thick layers of continental ice, so the present-day fauna must have arrived there since then. The two most important source areas for northern organisms are the area south of the continental ice (in what is now the United States), and the northwestern corner of North America (Beringia), which, during the last glacial period extended westward via the Bering Land Bridge into Asia. The black flies of the Horton drainage most closely resemble those of present-day Alaska and the Yukon Territory, suggesting that Beringia played an important role in repopulating the western barrenlands following deglaciation.

Naming Names

The Inuit are reputed to have many, perhaps dozens, of words to describe snow. In contrast, their entomological lexicon is rather sparse, with just a handful of names to describe the few insects that capture their interest (or ire) during the short Arctic summer. Perhaps not surprisingly, biting flies are relatively well endowed with Inuktitut and Inupiaq names, at least, relative to the more charismatic members of the barrenlands entomofauna—the butterflies, dragonflies, and beetles. *Milugiak* (black flies), for example, are readily distinguished from their close relatives *qikturiak* (mosquitoes) and *kirgavaitchauraq* (no-see-ums). No other group of insects is accorded such a finely divided taxonomy, although there are growing signs that additional words may soon be needed as the continent warms and species migrate northward.

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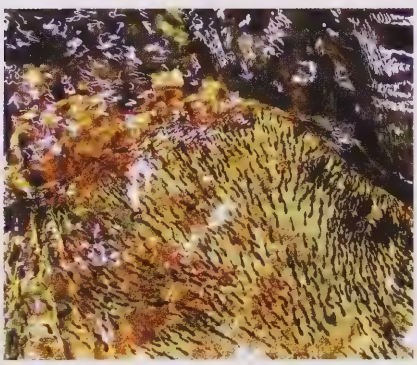


D. C. CURRIE, ROM

D. C. CURRIE, ROM

Top left: Preparing insect collections after a hard day's paddle on the Thelon River, Northwest Territories. Bottom left: A submerged rock bristling with the filter-feeding larvae of black flies. Right: Collecting immature black flies from the outlet of a tundra pond near Arviat, Nunavut.

In contrast, many of the species collected farther east in the Thelon River drainage and eastern Nunavut aren't found in northwestern North America, suggesting that southern refugia (areas in which a population of organisms can survive through a period of unfavourable conditions) played a relatively more important role in repopulating those barrenlands areas. Only 15 of 42 barrenlands species are common to all three collecting areas, highlighting the geographical and historical complexity of the region.

With the relatively recent arrival of black flies in the barrens, one can't help but wonder whether the species distributions are still in a state of flux. After all, the last 2.5 million years of Earth's history has been, in effect, an ice age. Who's to say that our current Holocene Epoch isn't just another in a series of interglacial periods?

Whether in flux or not, the black fly populations were not shy about alerting us to their presence. Author Malcolm Waldron in his 1931 biography, *Snow Man: John Hornby in the Barren Lands*, called the barrenlands black fly a "cruel parasite."

That "cruel parasite" turned out to be one of the few barrenlands black flies that had yet to be assigned a scientific name—it was by far the dominant human biter in the barrenlands. Peter Adler and I formally described that species in 2004, dubbing it *Simulium tormentor*—a reference to its rapacious capacity to savage the flesh. Some of our most trying moments in the field were the direct result of attacks from these vile creatures. They would persecute us from dawn until dusk, despite our bug jackets doused in DEET, giving us respite only during the short Arctic night.

Meals were especially challenging as we were forced to remove our head nets in order to eat. We became adept at cradling plates and bowls on our laps so that at least one hand was always available to fend off attacks. Although it gave us perverse pleasure when flies blundered haplessly into our porridge, this unwanted garnish imparted a gritty texture when enough of the scalded corpses accumulated in our gruel.

Repellants containing 98 percent DEET were moderately effective at keeping the flies at bay, but the corrosive effects of such "high octane" lotions meant repeated applications to exposed flesh were not a good idea. Inevitably, a small number of flies would breach our defenses, and they would gnaw furtively into the undefended capillary network beneath our skin. Because they inject an anaesthetic into the skin, it was only after they gorged and escaped that we had the first inkling that something was awry. Lifting a pant leg we would see the telltale droplets of blood oozing from raised itchy weals. These suppurating wounds would soil our clothing, but it was the ensuing itch that drove us to distraction.

We became adept at cradling plates and bowls on our laps so that at least one hand was available to fend off attacks

The midnight sun makes it difficult enough to sleep during the height of the Arctic summer, but the maddening itch of dozens of black fly bites, often on inconvenient or delicate parts, made restful slumber impossible. By a stroke of providence we discovered that camphor-based muscle relaxants such as Tiger Balm dampened the urge to scratch when slathered liberally on wound sites. Our supply, however, was low and its soothing effects—lasting an hour or two—were all too fleeting.

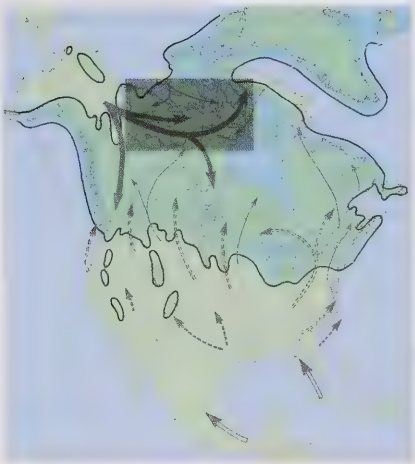
As challenging as it is for southern visitors to adjust to life on the barrens, it is difficult to imagine what misery indigenous birds and mammals go through. One episode in the Northwest Territories gave us an appreciation of the hardships endured by caribou. Late one morning, while paddling along the gin-clear waters of the upper Horton, we encountered part of the 120,000-strong Bluenose herd as it waded shoulder deep across the river.

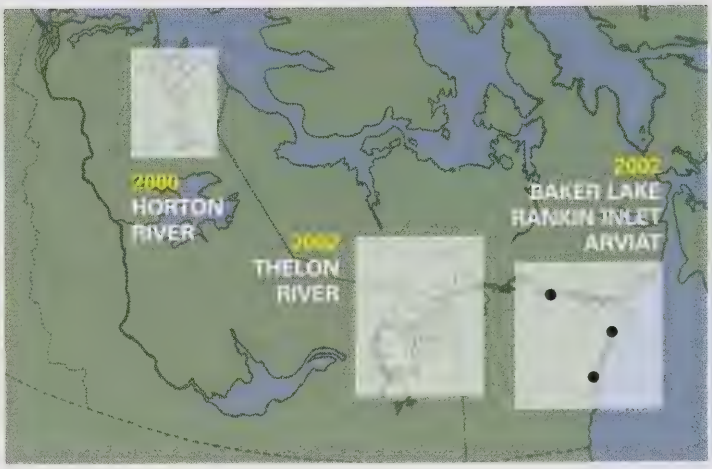
Despite our best efforts to backpaddle we drifted into their midst, causing a gap to form in the column of caribou. Our sense of awe was overtaken by horror—following in the wake of the herd were millions of hungry flies, many of which diverted their attention from the migrating animals to the slow-moving and sparsely clothed occupants of the canoes. We quickly scrambled into our bug jackets. It was little wonder that the caribou were constantly on the move.

During the course of our fieldwork we were fortunate enough to observe grizzly bears, caribou, muskoxen, wolves, and foxes—all the large mammals that inhabit the barrengrounds. Although none of these creatures is immune to attack, we currently have few clues about which species of black flies feed on which particular hosts.

The same is true for the association between flies and their smaller mammalian and avian (bird) hosts. Nonetheless, by examining particular details of the black fly's legs and mouthparts, we can infer that 20 of 43 species (46 percent) feed on the blood of mammals. In contrast, 15 species (35 percent) have a predilection for avian blood. The remaining 8 species (19 percent) lack biting mouthparts altogether and are called "autogenous."

Such non-biting species typically are rare in nature, comprising just 2.4 percent of the world's black fly fauna. Their relatively high numbers in the barrenlands can be attributed to the fact that black flies are approaching the northern limit of their ilk. The entire Canadian Arctic archipelago, for example, is home to just eight hearty species of black flies, and seven of those are non-bloodfeeders. With the availability of warm-blooded hosts growing scarcer as one proceeds northward, the ability to produce eggs in the absence of a blood meal allows autoge-





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D. C. CURRIE, ROM

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Top left: The arrows show the two source areas from which black flies repopulated the barrenlands after glaciation. The width of the arrows denotes relative contribution to repopulation. The black lines show the limits of glacial ice. Top right: The three areas visited over the course of the barrenlands black fly study. Middle: The ruins of John Hornby's cabin in the heart of the "Thelon Oasis." Hornby and his travelling companions, Edgar Christian and Harold Adlard, starved to death here in the early spring of 1927. Bottom left: The absence of trees and shrubs on the lower Horton River required that insect traps be deployed using a combination of canoe paddles, duct tape, and string tied to dwarf willows. Bottom right: Setting camp on the lower Horton River.

nous species to exist beyond the ecological range of "normal" bloodthirsty species.

Black flies, mosquitoes, and other biters such as tabanids and no-see-ums are conspicuous and abundant constituents of the arctic biota, at least during the summer when snow and ice melt. Permafrost inhibits meltwater from percolating readily into the soil, and the countless lakes, pools, and streams that dot the landscape are responsible for the mind-boggling numbers of these bloodsucking flies. Tiny as they are, their collective mass far exceeds that of all their hosts combined.

Unlike most biting insects, which typically complete their development in standing waters, black flies breed exclusively in running waters. Their larvae and pupae thrive in the mightiest rivers and the tiniest trickles. Little wonder, then, that black flies may be encountered everywhere on the barrenlands. In many instances they are the dominant species of the streams they live in. And in particularly rich habitats such as lake or pond outlets larvae can number nearly one million individuals per square metre. Under such densely packed conditions, their protein-rich bodies provide an inexhaustible source of food for predatory invertebrates, fish, and waterfowl.

They also have an enormous impact on the way organic matter is transformed as it flows downstream. The apex of the larval black fly's head is equipped with a pair of elegant rake-like appendages that extract dissolved organic matter and fine particulate organic matter from the water column. Because of their poor efficiency in digestion, larval black flies produce large numbers of fecal pellets with enough nutrition to support other aquatic invertebrates. Without the larval black fly's ability to capture and package the tiniest particles, much of the stream's energy would be unavailable to other invertebrates.

Just how important is black fly feces to arctic streams? A study on a river in northern Sweden found that the average daily transport of organic matter in the form of fecal pellets was a staggering 69.2 tonnes in dry mass. Clearly, larval black flies are integral to the food webs in which they live.

Despite the misery they can inflict on humans, we must admit that the consequences would be environmentally catastrophic if humankind ever finds a way to exterminate these organisms. Fortunately, the sheer volume of black fly habitat in Arctic Canada renders this scenario unlikely.

In fact, environmental changes may lead to increasing numbers of black flies in the north. Recent studies indicate that the Arctic is warming twice as fast as the rest of the planet. At the current rate of warming, the North Pole could be ice-free in summer by the year 2100. Even now, the Inuit are beginning to encounter new and unfamiliar species as their ranges are extended ever northward. One of our Inuit guides in Arviat was noticeably upset when he tried to describe a large and unfamiliar insect that he recently encountered near town. He didn't have the words to adequately describe the creature, and without a specimen it was difficult for us to render a credible identification. Could this be the vanguard of an invasion of insects from the south?

Just last summer a specimen of *Vespula intermedia*, or yellowjacket wasp, was discovered near the village of Arctic Bay on the northern tip of Baffin Island. At 73° north, this record represented a huge range extension for the typically southern species. Whether the yellowjacket at Arctic Bay was a freak occurrence or a harbinger of global climate change has yet to be determined.

Although it is difficult to predict how global warming will affect the distribution of barrengrounds black flies, it would be naïve to expect their numbers to diminish to any great extent. In fact, the most numerous and noxious denizens of the subarctic zone would probably migrate farther north to where they are now sparsely represented or absent.

In particularly rich habitats, such as lake or pond outlets, black fly larvae can number nearly one million individuals per square metre

This would surely signal the end of the "no fly zone" in northern mainland Canada—along with any prospect that migrating caribou have for finding safe haven during the summer. At the same time, some of the most notorious bloodsuckers of the boreal forest, such as the dreaded and aptly named *Simulium irritatum*, would migrate seamlessly into the habitats left vacant by *Simulium tormentor* and its associates. There is certainly no "up side" to global warming in terms of biting flies.

Adult black flies cause distress to their warm-blooded hosts and they may even induce death through blood loss, toxemia, and, in the case of birds, transmission of parasitic diseases.

How can one reconcile the costs and benefits of such "cruel parasites"? Northern mainland Canada remains one of the truly great wilderness areas left on earth. With only about 12,000 residents scattered among a dozen or so communities, the barrenlands have remained virtually unsullied since the retreat of the last glaciation. Traditional land-use practices such as hunting, trapping, and fishing continue to play an important role in the economy of the region, but economic imperatives dictate an increased emphasis on resource-based developments such as diamond mining. Whether such initiatives have a marked or lasting impact on the delicate environment remains to be seen.

Still, I can't help but wonder whether the omnipresence of black flies and their bloodsucking kin will ultimately dictate the intensity and duration of human incursions onto the tundra. There are times when black flies can render the barrenlands a veritable Hell on Earth, but it seems a small price for saving Eden. ■

MAP
The coloured map shows eight geographical divisions of Korea, still used to this day. Because Formosa is labelled as a colony of Japan but Korea as an independent country, it can be assumed that the set was prepared between 1895 and 1910.

985x5.20

Art on a Mission

THE WORK OF A RENOWNED KOREAN ARTIST PAINTS A VIVID PORTRAIT OF KOREA IN THE LATE 1800s—A COUNTRY THAT WAS THEN ALMOST ENTIRELY UNKNOWN IN THE WEST.

A-FRAME CARRIERS
Two men carry straw sacks of rice on an A-shaped carrier frame, a common mode of transportation throughout the Joseon dynasty.

985x5.24

PHOTOGRAPHY: BRIAN BOYLE, ROM

by Christina Hee-Yeon Han

Imagine travelling back in time to late 19th-century Canada. You are at your local church to attend a lecture on the missionary work in Korea given by a promoter of the international Christian mission. He comes in with a roll of paper bearing illustrations drawn by a Korean artist. The lecture begins. First, the presenter shows a map of Korea, explaining its location in relation to China and Japan.

After briefly introducing Korea's history, climate, and population, he goes on to describe the daily life of Koreans. The audience is rapt.

MAKING HORSEHAIR HATS
Shows the process of making a horsehair hat, widely worn by Korean men.

985x5.31

You view paintings that portray production and commerce. When he talks about the Korean language, the lecturer shows Korean words in coloured letters and explains how Korean differs from Chinese and Japanese. Turning to a scene of a traditional school, he discusses Korea's educational system and the new missionary schools, where children are taught Christian hymns. He then moves on to describe problems, such as social disparity and ill treatment of women—accompanied by paintings of the wealthy and the poor, and of women's daily activities. He concludes with a discussion of traditional religious practices and the history and future of the Christian mission in Korea.

What would have made this presentation so exciting was the novelty of learning about anything Korean. It was not until the late 19th century that Korea, Land of the Morning Calm, began to become known to the general public in the West—in 1882. That's when Korea signed the Treaty of Amity and Commerce with the United States and the door to this Far Eastern country officially opened to the West.

Early delegates and missionaries to Korea wrote reports about this unknown land, returning home with intriguing stories as well as wonderful images—paintings by Korean artists.

Among the works that made their way to the West, those of one particular artist outnumbered all others—genre painter

PROCESSION OF GROOM'S PARTY
A representative of the groom's family accompanied by two attendants.

985x5.38

Gim Jun-geun, more commonly known by an artist pseudonym, Gisan. Particularly favoured by Western visitors to Korea, his paintings were used as illustrations in late 19th- and early 20th-century books introducing Korea to a Western audience. British army captains, ethnographers, and wealthy merchants were some of Gisan's prominent customers. Quickly he became the best-known Korean artist throughout Europe and North America. Today, the ROM's H. C. Mu Library holds several books containing Gisan's watercolours.

Intriguingly, a set of genre paintings attributed to Gisan, donated to the ROM in 1985, was recently rediscovered in the Museum's collection rooms. The set features a map of Korea on the first page, followed by 27 paintings and four calligraphies of Christian hymns. Though the early history and vicissitudes of the set are not known, the map, which labels Formosa as a colony of Japan, but Korea as an autonomous country, suggests that the set was produced between 1895 and 1910—between the year of the Japanese occupation of Formosa and that of Korea. This series of paintings illustrating traditional Korean life captures the essence of the socio-cultural milieu in late 19th- and early 20th-century Korea and is one of the few sets likely used as documents for promoting the Christian mission in Korea.

Gisan was a prolific artist. The number of works attrib-

PENCILLED NOTES
Two distinct styles of handwriting would seem to indicate that two people were responsible for the pencil marks at the bottom of the paintings. The remarks in Korean reflect an interest in Korean language.

PILGRIM'S PROGRESS
Christian and Hopeful meet with angels. A scene from Gale's 1895 translation of *Pilgrim's Progress*. The illustrations were done by Gisan. Notice the interesting rendering of all figures as Koreans.

uted to him verges on a thousand. Yet despite such a productive artistic career, he left behind scant information about his personal history. Much of what is known comes from his interaction with Western visitors. We know that he worked in Jemulpo, Busan, and Wonsan—major port cities where a foreign presence was most strongly felt. As a genre painter, Gisan was interested primarily in documenting aspects of traditional life, although he also produced some landscape paintings. Typically, Westerners commissioned his work, and as we will see later, it is likely that the ROM's Gisan set was itself produced as a special order.

Gisan's paintings are distinguished by several characteristic qualities: they have much-reduced, sometimes nonexistent, backgrounds and feature centralized figures with egg-shaped faces, somewhat pointed chins, proportionately large heads, similar features, and serene expressions. Usually, the figures are shown participating in a variety of daily or festive activities. Small in size, commonly measuring 15-20 x 15-20 cm (6-7¾ x 6-7 ¾ inches), Gisan's paintings are often found in album format or as individual folios.

Scholars can trace two major influences in his paintings: Korean genre painting and Chinese export painting. Begun in Korea in the 18th century, the genre-painting tradition was led by a group of artists interested in depicting scenes from the life

SHAMAN PERFORMING "GUT"
A *mudang* (female shaman) conducting "Gut," a ritual that merges strong theatrical dramatics with music and dance. She invokes the presence of spirits and receives oracles from them. The bright colours and ornamental designs of her costume and implements are captured in the painting.

985x5.48

and work of ordinary people. Like the early masters, Gisan focused on the activities of daily life, but expanded upon the earlier tradition with more diverse subject matter, creating easily recognizable thematic groups, such as paintings about festivals, religious practices, or modes of production. He also reduced the paintings' dimensions—which were typically twice the size—making them easier for Western buyers to carry home.

Stylistically, his work resembles that of earlier genre painter Gim Hongdo, known by the artist pseudonym Danwon (1745-?). Like Gisan's works, Danwon's paintings are characterized by minimal backgrounds and highlighted figures in action. Danwon's work, however, reveals an innate humour (an image of a crying boy just chastized by the school teacher shows his friends quietly laughing in the background), which is negligible in Gisan's paintings. While Danwon tried to capture distinct personalities, Gisan was more interested in accentuating the events themselves—the way people do things—emphasizing documentary and illustrative qualities.

The second influence was in Gisan's method of production; in this respect his genre paintings are similar to 18th-century Chinese export painting. Primarily created for foreign clients, the Chinese works were mass-produced in professionally organized workshops. Both the sheer volume of Gisan's work and the repeated appearance of familiar

FIELD SCENE
Three figures in the background bear close resemblance to figures in petite-sized works by the artist.

985x5.22

themes suggest that he, too, produced his paintings in a workshop. Like the Chinese prototypes, Gisan's watercolours often feature elucidatory titles added to boost understanding by Western buyers. He often added his artist's seal and signature to his paintings, although these are not found on the ROM's set of paintings.

The finding of Gisan's paintings in Canada is not surprising because of the artist's close relationship with Canadian missionaries, especially James Scarth Gale. The name Gale may sound familiar to ROM history buffs, since this family has been a major contributor to the ROM's Korean collection. A Canadian missionary to Korea from 1888 to 1928, Gale (1863–1934) was born in Alma, Ontario, graduated from the University of Toronto in 1888, and that same year arrived in Korea. It is said that he first met Gisan in 1889 in Busan and together they moved to Wonsan in 1892. Three years later, in 1895, Gale published the Korean translation of John Bunyan's *Pilgrim's Progress*—the first Western literary work to be translated into Korean. Gisan produced the illustrations. An original copy of the work, presented to the University of Toronto by Gale himself, is now kept in the U of T's Thomas Fisher Rare Book Library.

The ROM's set of Gisan paintings is of particularly fine quality. While some works from other collections are

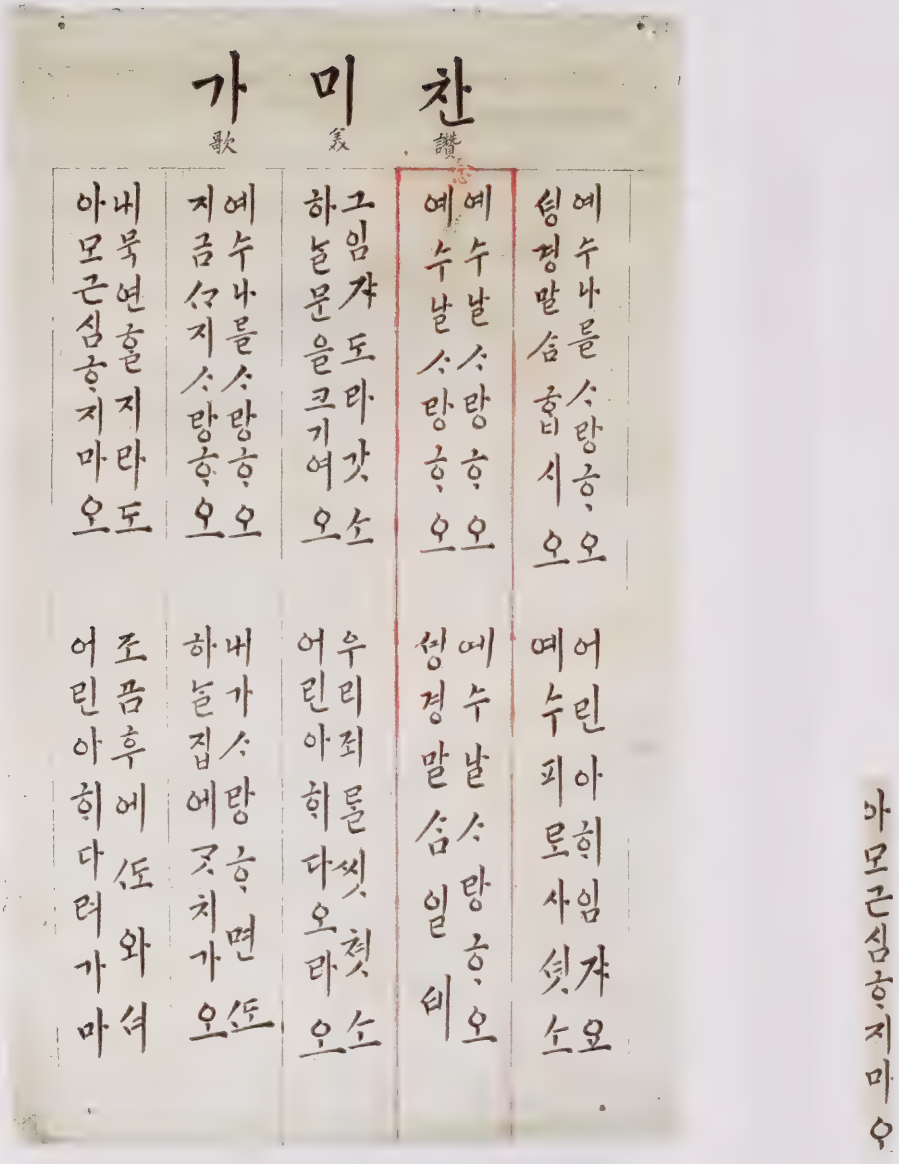
ANCESTOR WORSHIP
Three spirit tablets are enshrined in a house-shaped shrine and a ritual table is prepared for the ancestors.

985x5.52

sketchy and inconsistent, the ROM's paintings are fully and brightly coloured, with carefully captured details. In the painting *Shaman Performing "Gut,"* for example, the artist meticulously rendered details of items used by the shaman (*mudang*), specifically highlighting her fan, colourfully adorned with a design of three seated Buddhas, and a conscientious table setting for the spirit of the dead.

Gisan's works can be divided into those done in black ink and those done in colour. The two types exhibit different brushwork. Those in ink tend to be more fluid looking and display a wider range of brushwork based on the traditional landscape painting tradition; the coloured paintings have a more rigid quality and less variation of brushwork. What makes the ROM's Gisan collection special is that the painter successfully integrated both styles. In the painting *Field Scene*, for example, a variety of types of brushwork are visible—more spontaneous and fluid strokes for delineating the landscape, bold and quick dots for filling in the space, and a fine and meticulous brush for articulating the figures.

Yet perhaps the most distinctive feature of the set is its unprecedented purpose—illustrating a lecture presentation. When the paintings first arrived at the ROM, the set was bound at the top edge by a wooden pole. Departing from the more commonly seen miniature-size paintings, those in the



CALLIGRAPHY OF CHRISTIAN HYMN *JESUS LOVES ME*
Calligraphy of four hymns, including this one, suggest the set's connection to the Christian mission.

985X5.34

ROM's group measure 123 cm x 71 cm (48 x 28 inches), the largest of any works by Gisan.

The set includes calligraphies for four Christian hymns—"Jesus Loves Me," "Nothing but the Blood of Jesus," "There is a Happy Land," and "Creation"—plus quotes from the Bible and facts about the history of the Christian mission in Korea pencilled on the bottom of some of the paintings, which attest to the set's connection to the mission.

Most likely, the ROM's set of Gisan paintings was prepared and used in a presentation on the Christian mission in Korea, much like the one imagined at the beginning of this article. It was probably specially ordered. The map on the first page, for instance, is clearly a reproduction of a Western one—which likely was provided to the artist—and the locations labelled in roman script also show the touch of a Western hand. Except for the United States and the United Kingdom, Canada sent more missionaries to Korea than any other country.

In the ROM's Gisan watercolours, the content deals chiefly with modes of production and religious activities. Seventeen paintings portray scenes of agricultural production, manufacture of ceramics, textiles, headdresses, and matches, as well as carpentry, livestock raising, hunting, manual labour, and commercial activity. A religious theme, found in six paintings, covers

FLYING KITES ON NEW YEAR'S DAY
Kite-flying was a popular winter game. Children received colourful clothes to wear on New Year's Day.

985x5.32

shamanistic practices and ancestor worship.

Even though Gisan also depicted other themes in other sets of paintings, such as customs, entertainment, and penal codes, the reason for the particular emphasis on economy and religion in the ROM's set perhaps can be understood when we consider the purpose of it: this set was less about introducing Korea in its entirety and more about promoting the Christian missionary work in Korea, which focused on teaching a new faith and providing aid and medical assistance to those in need.

The discovery of the Gisan compilation in the ROM's collection rooms is significant in several ways. It marks the first finding of the artist's work in a large-scale format for public presentation. And it reaffirms the artist's connection with the Canadian Christian missionary effort in Korea in the late 19th century. The ROM's set of paintings is a visual testimony of the influential role Gisan played in introducing Korea and its people to Canadians through his creative works.

When we examine these evocative images in connection with the pencilled notes, we discover a clear sequential progression, enabling us to reconstruct and imagine the way a missionary first presented them to his eager Canadian audience more than 100 years ago. ■

Tiny Pavarottis

Composed of anywhere from one to 150 notes, the songs of many mice change in pitch, time, and tempo. Studied closely, the "music" reveals that these tiny mammals are communicating.

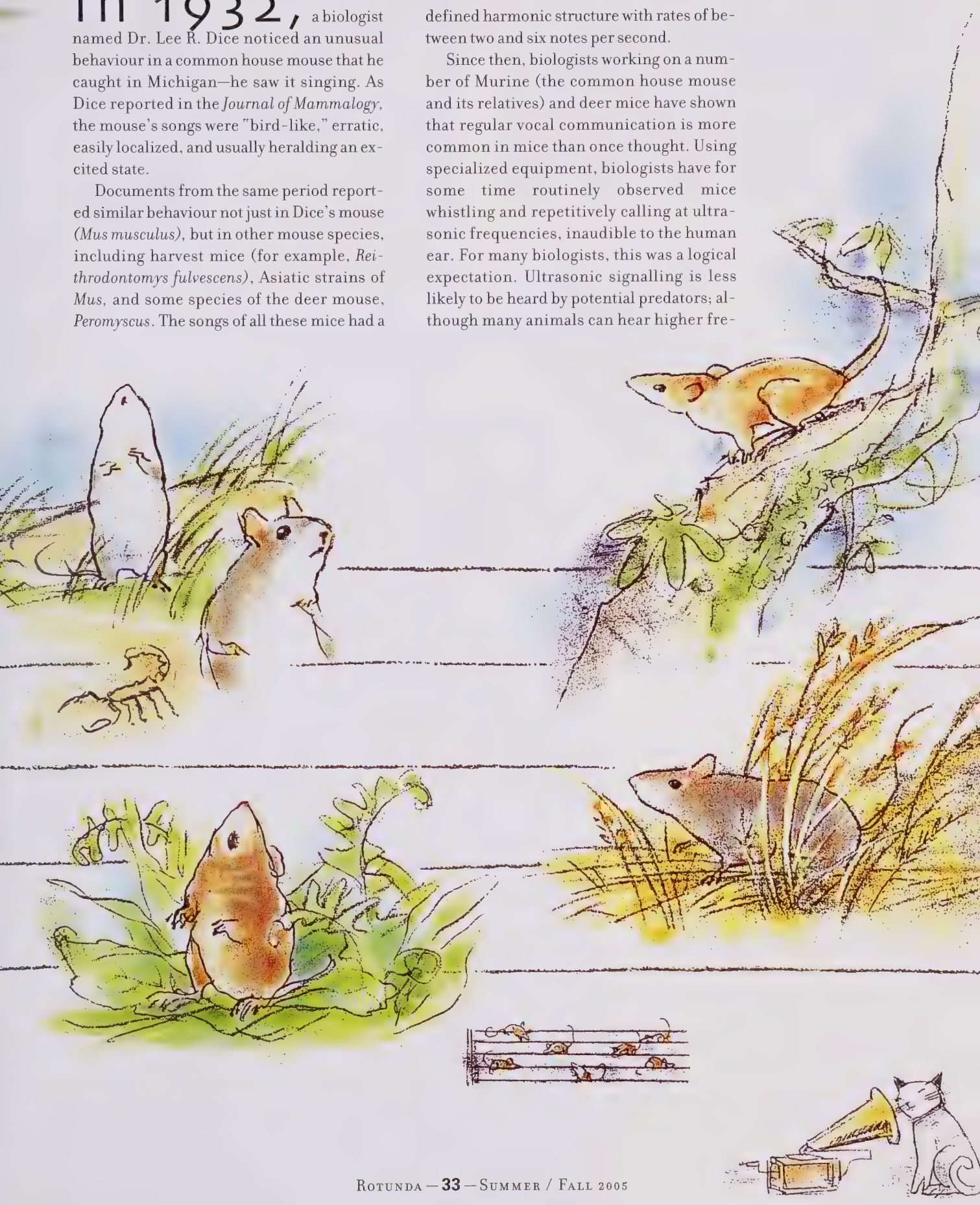
Jacqueline R. Miller

GENEVIÈVE CÔTÉ

In 1932, a biologist named Dr. Lee R. Dice noticed an unusual behaviour in a common house mouse that he caught in Michigan—he saw it singing. As Dice reported in the *Journal of Mammalogy*, the mouse's songs were "bird-like," erratic, easily localized, and usually heralding an excited state.

Documents from the same period reported similar behaviour not just in Dice's mouse *(Mus musculus)*, but in other mouse species, including harvest mice (for example, *Reithrodontomys fulvescens)*, Asiatic strains of *Mus*, and some species of the deer mouse, *Peromyscus*. The songs of all these mice had a defined harmonic structure with rates of between two and six notes per second.

Since then, biologists working on a number of Murine (the common house mouse and its relatives) and deer mice have shown that regular vocal communication is more common in mice than once thought. Using specialized equipment, biologists have for some time routinely observed mice whistling and repetitively calling at ultrasonic frequencies, inaudible to the human ear. For many biologists, this was a logical expectation. Ultrasonic signalling is less likely to be heard by potential predators; although many animals can hear higher fre-



quencies than humans can, the range of optimal hearing in many predators is much more restricted.

What is surprising, though, is that singing that is audible to the human ear, as in Dice's mouse, is common in a variety of mice, which regularly and preferentially vocalize in this way. For a small mammal under high risk of predation, this audible signalling provokes some perplexing questions about how vocal behaviour evolved in mice.

I first began my doctoral research with an interest in primates, hoping that through them I could develop a model to study vocal communication among mammals in general. It was during a Nicaragua field season with my supervisor, Dr. Mark Engstrom, in February 2001, that my focus was redirected. During that trip we had collected a single specimen of what is colloquially known as Alston's singing mouse. As we sat discussing this mouse over a beer in an El Salvador airport, we compared notes on its ecology, anatomy, and systematic relationships.

Suddenly, we realized that we had stumbled on what could prove to be one of the most appropriate models for vocal communication existing in mammals. We realized that the deer mice of the New World and their relations—a group to which Alston's mouse belonged—satisfied the conditions of the comparative doctrine: the group included numerous species inhabiting various ecological settings and social conditions. And, equally as important, we had the means to uncover their evolutionary relationships—or branches on their family tree.

We would need to take this comparative approach—in the best tradition of Nicolas Tinbergen, the father of modern ethology (the science of animal behaviour)—to truly understand the evolution of vocalization. Comparative biology looks at a group's evolutionary history as well as functional and mechanistic information, and individual development through the lifespan. A good model must include many species both closely and more distantly related, representing a variety of ecological and social conditions. This diversity is essential to testing hypotheses about evolution.

Since that realization in El Salvador, my studies have explored the evolutionary factors likely to have shaped vocal behaviour in mice—among them courtship, competition, habitat, and species history.

Any kind of communication involves both a sender and a receiver, and to be useful to either, the mode of communication must convey motivation and intent, as well as identity. The benefits of relaying reliable information are several: successfully competing for space or resources, locating separated offspring, or recruiting a mate.

At the heart of understanding the origins of such communication systems is the nature-nurture conflict. Which variables are genetic and which environmental? On the nature side, biologists have long thought that loud "long calls," which many mammals, including mice, use to advertise territory, can encode information about the call's history. Biologists believe that calls of this kind have remained relatively unchanged through history. The calls reflect only the amount of genetic variation common to a group, and not enough to differentiate individuals. Many long calls therefore carry acoustic data unique to a species, a kind of species "label." The call lets a listener recognize which species is signalling.

On the nurture side, environmental studies have shown that the physical conditions through which signals are transmitted can have a profound effect on calls. In fact, over time, the features adapted for habitat can become fixed, and become part of the animal's evolutionary legacy. Social habits (for instance, monogamy versus gregariousness) and social behaviour (for instance, courtship and mating), too, can strongly influence patterns and use of vocal signalling. Vocal characteristics, then, can reveal something about the evolution of the vocal behaviour itself.

Among the New World mice, at least four distinct genera make powerful calls that are repeated identically or in identical sequence: *Reithrodontomys*, *Onychomys*, *Scotinomys*, and *Baiomys*. While each genus has its own distinct calling pattern, this type of repeated call, known as stereotypy, is a key part of a mouse's repertoire—and suggests that such vocalizations transmit important information.

Two of these "singing" mouse genera belong to the tribe Baiomyini—*Baiomys* (pygmy mice) and *Scotinomys* (singing mice). Both anatomical and DNA evidence have shown that

SCOTINOMYS TEGUINA

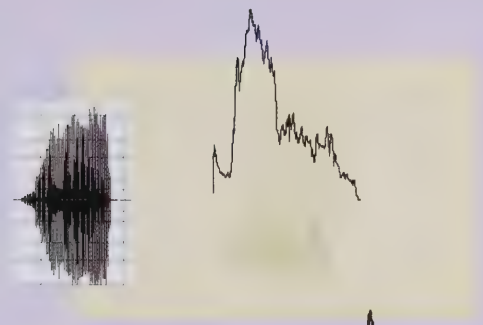
*Song Characteristics**	**Male**	**Female**
Duration	9–11 sec	6–7 sec
Number of Notes	81–171	50–125
Minimum Frequency	10–11 kHz	42–43 kHz
Maximum Frequency	11–12 kHz	40–41 kHz

SCOTINOMYS XERAMPULINUS

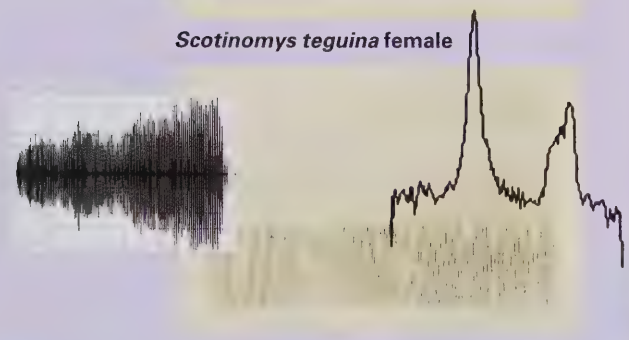
*Song Characteristics**	**Male**	**Female**
Duration	2–3 sec	1.5–2 sec
Number of Notes	25–45	18–34
Minimum Frequency	10–11 kHz	11–12 kHz
Maximum Frequency	33–34 kHz	32–33 kHz

* DURATION AND FREQUENCY REPRESENT AVERAGE, ROUNDED VALUES AND THEIR CONFIDENCE INTERVAL. FREQUENCY BASED ON ASSUMED CARRIER

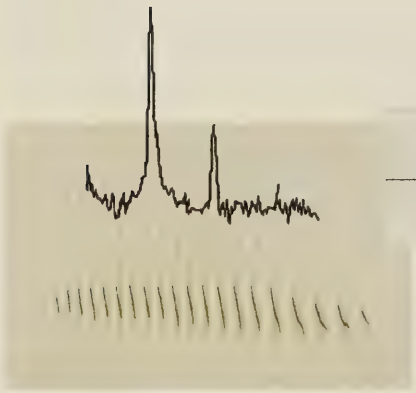
Scotinomys



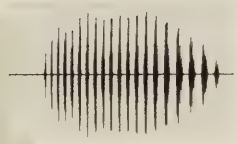
***Scotinomys teguina* female**



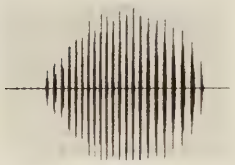
***Scotinomys teguina* male**



Baiomys musculus

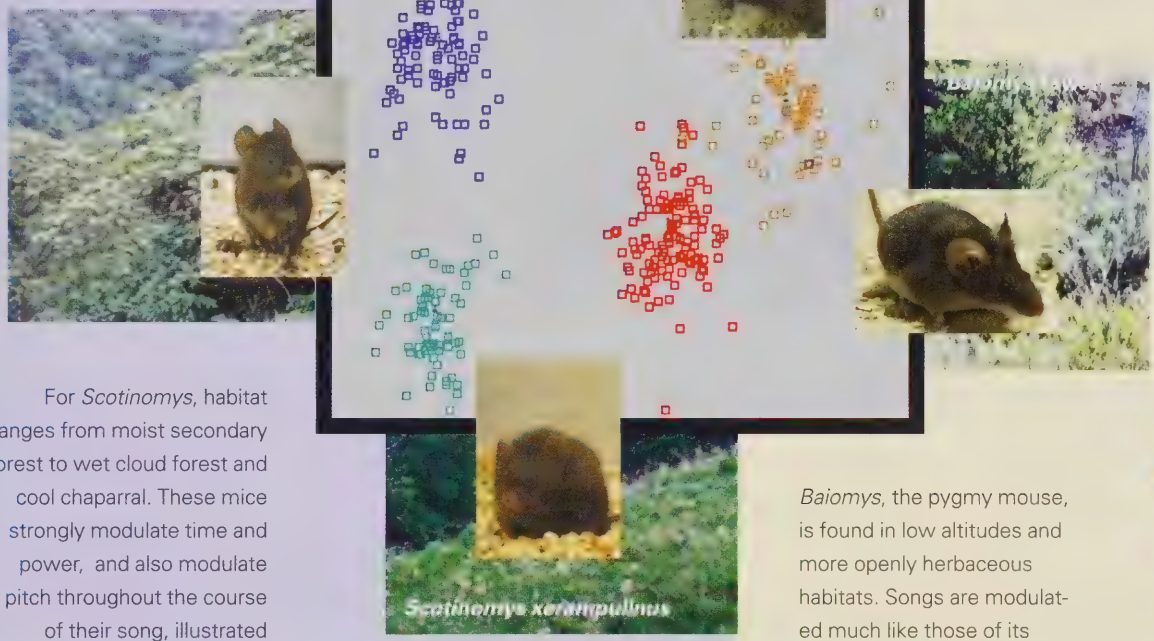


***Baiomys taylori* male**



***Baiomys taylori* female**

Scotinomys teguina



For *Scotinomys*, habitat ranges from moist secondary forest to wet cloud forest and cool chaparral. These mice strongly modulate time and power, and also modulate pitch throughout the course of their song, illustrated respectively by (from left to right) the oscillogram (time versus power) and the sonogram (time versus pitch). A power spectrogram (measures the energy different frequencies have in the call) is superimposed on the latter, to illustrate aspects of spectrographic, or frequency, analysis. Differences appear between males and females: the song of a female *Scotinomys teguina* is short (6.05 seconds), compared to the protracted song of a male (12.55 seconds).

Aspects of acoustic features combine in different ways to create distinctive identities, not only for individual species but for larger taxonomic groups such as genera. The discriminant function analysis (DFA) plot shown above compares range of pitch and degree of complexity, clearly distinguishing *Scotinomys* from *Baiomys*. Attributes of duration, tempo, and, to a lesser degree, maximum pitch help define species "labels."

Baiomys

Baiomys, the pygmy mouse, is found in low altitudes and more openly herbaceous habitats. Songs are modulated much like those of its relation *Scotinomys*, but are shorter and less complex (call length approximately 1.55 to 2 seconds) with songs of males (top oscillogram) and females (bottom oscillogram) almost indistinguishable. Both sonogram (left) and oscillograms (right) illustrate these differences between the two genera.

the Baiomyini are a closely related group, a finding further strengthened by the discovery that both genera produce strongly modulated vocal signals. Similarities in their songs reflect the group's common ancestry.

The "songs" of the Baiomyini are noteworthy for their length, complexity, and elaborate use of the acoustic spectrum. Composed of anywhere from 7 to more than 150 notes to a "tour"—or repeated series comprising a song—each consecutive note changes not only in pitch, a phenomenon called frequency modulation (FM), but also in time and tempo, known as temporal modulation. Interestingly, Baiomyini frequency modulation bears a striking resemblance to the echolocation of bats, an indication of the method's usefulness for locating and being located.

When Baiomyini mice sing, making their loud or "long" calls, they often strike a pose, standing erect with mouth agape and body and neck extended. This postural behaviour—which occurs most notably in the genus *Scotinomys*, to which Alston's singing mouse belongs—is observed in a variety of other mammals, including wolves, foxes, and primates such as the howling monkey *Alouatta*. These postures increase the available resonant space in the throat and in the bronchial tree, amplifying sound.

It was the cornerstone 1976 work of American biologists Emmett Hooper and Michael Carleton that first introduced the characteristic long calls of *Scotinomys*. These mice modulate pitch and the length of each note throughout the course of the strongly repetitive elements of their song.

Very little was known about female signalling, and our work at the ROM has expanded this knowledge, capturing some of the first ever information on the females of *Scotinomys xerampulinus*. Females of two species *Scotinomys xerampulinus* and *Scotinomys teguina* sing, but their songs are significantly shorter and seem to have higher minimum frequencies than those of males. Females also vocalize far less often.

At the Museum, we are interested in discovering whether the female's singing is patterned according to the mouse's reproductive, or estrus, cycle. If so, it would suggest that the call has a role in advertising reproductive state, playing a part in courtship. Our work forms only part of a growing interest in the behaviour and biology of singing mice, with many notable discoveries emerging from progressive labs such as that of Dr. Steve Phelps of the University of Florida, Gainesville.

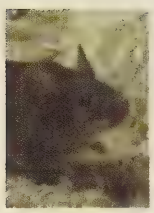
As for *Baiomys* or the pygmy mouse, until now almost nothing was known about its vocal behaviour, and most accounts were only anecdotal. Mammalogist W. F. Blair described the call of *Baiomys taylori subater* as a "high-pitched, barely audible squeal," whereas other mammalogists described the call as "staccato-like," similar to the song of *Scotinomys*.

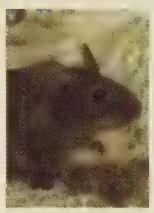
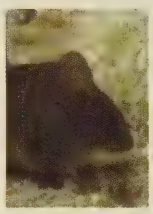
Through patient observation we have documented the first quantified description of singing behaviour in pygmy mice. Like those of *Scotinomys*, the pygmy mouse's songs are frequency modulated, but are much shorter, purer in tone (emphasizing a narrower segment of the sound spectrum), and less complex. They also show no noticeable dimorphism—the songs of males and females are almost indistinguishable.

Growing evidence is suggesting that ultrasonic vocal signalling (inaudible to the human ear) may be a comparatively old feature of rodent communication. Particularly where a trend in acoustic features—for example, a call that gets longer and longer across evolutionary time—is seen among different species and genera, the implications are interesting. Such trends, discovered by determining in what order the individual species branched off the New World mice family tree, can suggest historical transitions, such as

REITHRODONTOMYS

*Song Characteristics**	**Male**	**Female**
Duration	about 1 sec	about 1 sec
Number of Notes	1–2	1–2
Minimum Frequency	9–10 kHz	14–15 kHz
Maximum Frequency	? 15–16 kHz	? 24–25 kHz




BAIOMYS MUSCULUS

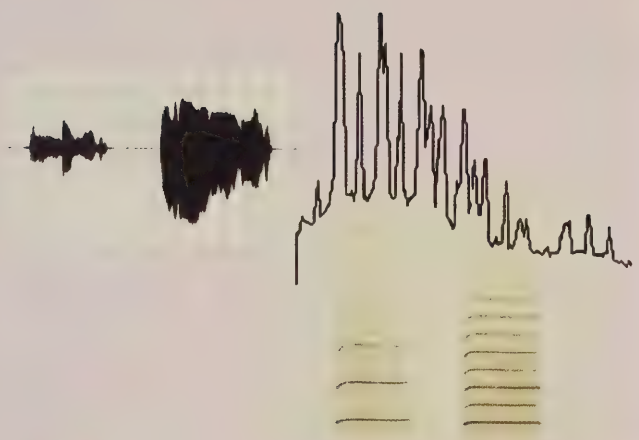
*Song Characteristics**	**Male**	**Female**
Duration	2–3 sec	2–3 sec
Number of Notes	18–29	14–30
Minimum Frequency	26–27 kHz	26–27 kHz
Maximum Frequency	47–48 kHz	49–50 kHz

BAIOMYS TAYLORI

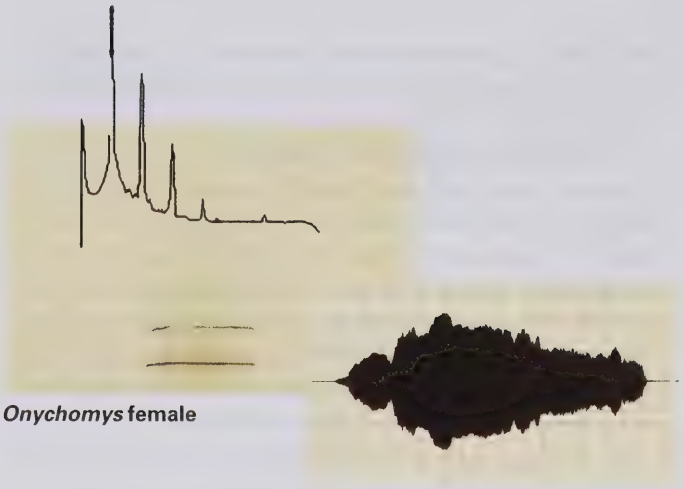
*Song Characteristics**	**Male**	**Female**
Duration	1.5–2 sec	2 sec
Number of Notes	7–28	13–39
Minimum Frequency	21–22 kHz	21–22 kHz
Maximum Frequency	39–40 kHz	38–39 kHz

* DURATION AND FREQUENCY REPRESENT AVERAGE, ROUNDED VALUES AND THEIR CONFIDENCE INTERVAL. FREQUENCY BASED ON ASSUMED CARRIER.

ALL PHOTOGRAPHY AND GRAPHIC BY JACQUELINE MILLER EXCEPT WHERE NOTED

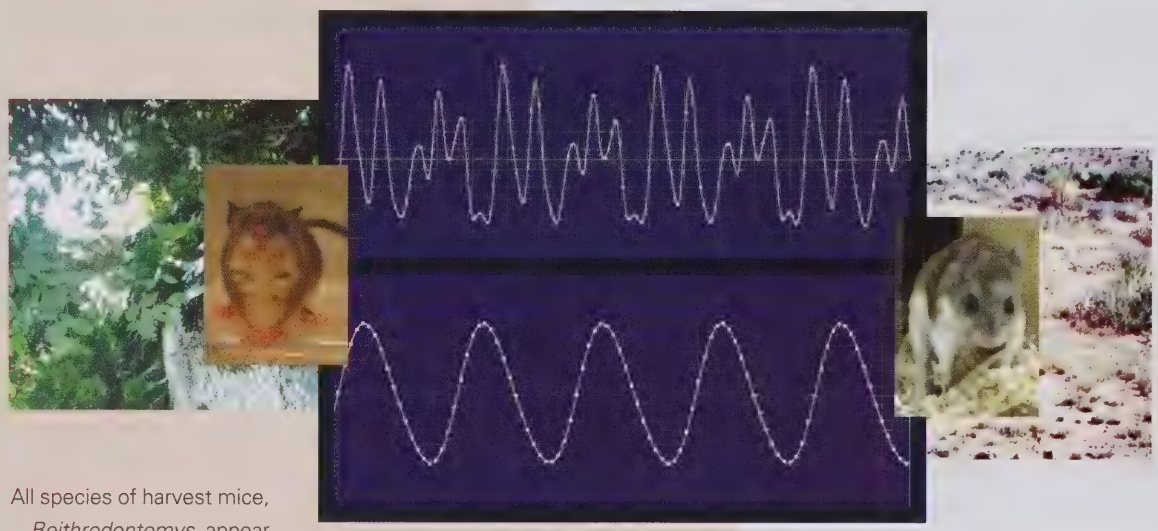


***Reithrodontomys* female**



***Onychomys* female**

Reithrodontomys



All species of harvest mice, *Reithrodontomys*, appear capable of emitting audible vocal signals, however, not all do so routinely or with repetition. Harvest mice with audible songs have been found in wet, forested, tropical habitat and spend a good deal of time in vegetation and in trees. Calls are typically one and two notes, as shown on the oscillogram (left) and sonogram (right). The superimposed spectrogram illustrates the harmonic structure characteristic of this mouse.

The graphs showing modulation of amplitude directly above represent a tiny snapshot of time—one wavelength equalling only 0.1 millisecond or less—but clearly show the harmonically complex signals of *Reithrodontomys* (top) versus the purer and more highly controlled ones of *Onychomys* (bottom). This modulation of amplitude provides an additional means by which species can be distinguished acoustically.

All species of the grasshopper mouse, *Onychomys*, live in open habitat and dry conditions, such as the barren landscape near Marfa, southwestern Texas. The oscillogram (right), typically a few seconds long, illustrates the characteristic peal of the loud-long call of a female *Onychomys leucogaster*, with its simpler harmonic structure and strong amplitude characterized by the sonogram (left) and superimposed spectrogram.

Onychomys

changes in body size or ecology in a lineage of mice.

Notably, the *Scotinomys* and pygmy mice use different ends of the acoustic spectrum. *Scotinomys* songs use some frequencies easily perceived by humans, even at some distance. The pygmy mouse's signals, on the other hand, are purely ultrasonic and above the range of our hearing—and that of many potential predators as well, unless at short range. What may help explain this difference is that *Scotinomys* is diurnal, active during daylight, when audible calling may be less risky than at night when predators are most active. This is

particularly important since the very attributes of frequency-modulated signals allow the caller to be quite easily located.

The Elements of Sound

Frequency is one means of describing sound. Sound is generated in waves, and the length of the waveform—or "wavelength"—determines the frequency. Frequency itself is defined as the number of cycles, or complete waveforms, that occur in one second. Thus high frequencies represent many complete cycles in a second and have short wavelengths. One "hertz" (Hz) is equal to one cycle per second and one "kilohertz," (kHz) 1000 cycles per second.

Frequency modulated sound is sound that uses a broad range of the sound spectrum—broadband sound. Bandwidth is measured by subtracting the minimum from the maximum frequency for a given unit, or moment, of time. Modulated frequency sound helps a listening mouse determine its position relative to a mouse that is calling—since some frequencies carry further in space than others, it provides a clue as to how far away and in what direction another mouse is travelling. It comes as no surprise that frequency modulated calls are used by many infant mice of different species—it allows them to be located if they fall out of a nest.

Harmonics—higher octaves of the original frequency—can also be used to judge whether an animal is moving toward or away from another because the higher octaves lose power more quickly than lower ones.

ONYCHOMYS LEUCOGASTER

*Song Characteristics**	**Male**	**Female**
Duration	1–1.25 sec	1–1.25 sec
Number of Notes	1	1
Minimum Frequency	9–10 kHz	8–9 kHz
Maximum Frequency	14–15 kHz	14–15 kHz

* DURATION AND FREQUENCY REPRESENT AVERAGE, ROUNDED VALUES AND THEIR CONFIDENCE INTERVAL. FREQUENCY BASED ON ASSUMED CARRIER

Mouse and Home

While the type of call given by any mouse is constrained by the mouse's body structure and genetic make-up, it can also be influenced by the physical characteristics of the environment in which the call is transmitted. The different environments occupied by New World mice, both now and in the past, have likely influenced their vocal behaviour, helping to shape the pattern of its evolution.

Any habitat poses a challenge to vocal communication: how to maintain sound clarity over distance and how to minimize sound distortion through varying degrees of environmental clutter. We would expect species living in different habitats to develop different vocal properties that would reflect the challenges of their particular acoustic landscapes. What we need to determine is if this is in fact what happens. What kind of challenges does a habitat impose on how a vocal signal is carried? What acoustical alternatives are available for a mouse to use?

For *Scotinomys*, habitat is confined to pre-montaine forest in Central America, from Chiapas, Mexico, to western Panama. This ranges from moist secondary forest and forest edge to wet cloud forest and cool chaparral. The pygmy mouse ranges from Texas and western and central Mexico, to a small area in northern Nicaragua, in the vicinity of Esteli. The pygmy mouse is found in low altitudes and more openly herbaceous habitats, including coastal prairie, oak savanna, and mesquite scrub, as well as dry brush and weedy fields.

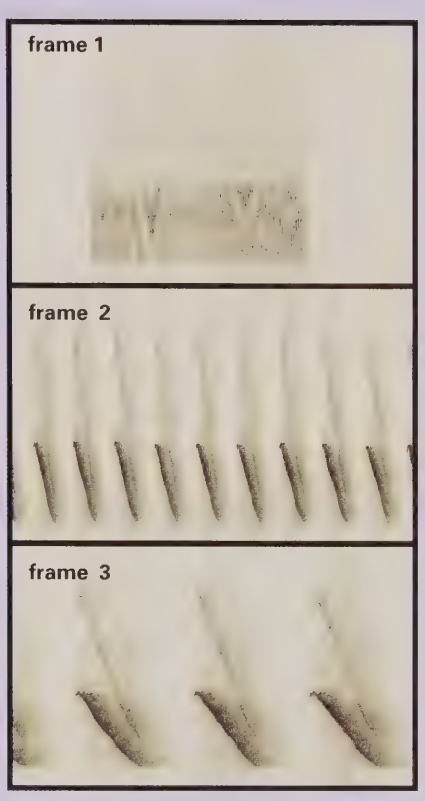
While these environments vary in clutter and density, the denser environments should favour higher frequency calls (those with shorter wavelengths), which would distort less easily and pass between stands of vegetation more readily. While this is indeed what we observe with pygmy mice, the picture is less clear with *Scotinomys*, whose modulated call reaches lower frequencies, and therefore has a longer wavelength.

Used reciprocally, however, frequency modulated or FM signals become ideal instruments for territorial marking and inter-individual spacing, particularly where visibility is poor. At the higher-frequency end of a typical FM call, energy dissipates more quickly and carries shorter distances. In this way, FM offers a means of judging whether the caller is advancing or moving away. For mice who range through territory where clutter impairs visibility, this type of call can help them identify the location and proximity of other mice.

Probably, the rhetorical (announcing space or entity) yet occasionally reciprocated songs of the pygmy mice function in this way—for territorial marking and spacing. Because the sexes give similar calls, these songs likely do not contribute significantly to reproductive behaviour, and are unlikely to be used as a criterion in mate selection. The dimorphic (different male and female) songs of *Scotinomys*, however, suggest another layer of function in this genus: a role in mate identification and selection.

Harvest mice (genus *Reithrodontomys)* also use repeated vocal signalling. This group's many species are divided into two distinct sub-genera: *Reithrodontomys* and *Aporodon*. While *Reithrodontomys* extends from southwestern Canada to Central America, *Aporodon* inhabits the central part of the Mexican Plateau and extends as far south as Colombia and Ecuador. All species of the genus appear capable of emitting audible vocal signals, but not all do so routinely or with the

modulation



The songs of the *Baiomyine* mice are composed of anywhere from around 7 to more than 150 notes, each consecutive note changing in pitch, a phenomenon known as frequency modulation. This is best observed by looking at the individual notes in a call, as seen in this sonogram of *Scotinomys teguina*, through enlarging "snapshots" in time. Each individual note is only a fraction of a second, best measured in milliseconds.

repetition that characterizes vocal stereotypy.

So far, observations have shown that all the harvest mice that vocalize are members of *Aporodon*, and most of these belong to the *Reithrodontomys mexicanus* species-group. For a number of these mice, a great deal of their activity occurs up in high vegetation and trees. In their natural habitat, these mice typically begin singing shortly after dusk, with their songs often emanating from the canopy. In the Neotropics, it is easy to mistake these calls for those of tree frogs. But the subtle frequency change between first and second notes of a typical two-note call reveals their mouse identity.

Tree-dwelling may be a factor in how the calls evolved—the songs carry for significant distances and can be heard from tree to tree. In fact, evidence of anatomical adaptations, such as a semi-prehensile or grasping tail, suggests that tree-dwelling is a deeply rooted ecological trait in these mice.

Faced with the challenge of an uneven, cluttered, and discontinuous habitat, as well as the problem of distance between stands of vegetation and trees, vocalizing harvest mice must use calls that are suited to an arboreal habitat. Reflective surfaces can distort acoustic waveforms, decreasing their power. While constant frequency signals—those that are unmodulated—carry well over distance, they are less well suited to deal with clutter than are frequency modulated or broadband calls. And while ultrasound, with its short wavelengths, works well in cluttered environments, it has the disadvantage of fading rapidly. It works over short distances only.

Biologists have observed *Reithrodontomys mexicanus* using signals characteristically unmodulated, intense in power, and narrow in bandwidth in the carrier frequency (frequency with the most energy), but with distinct harmonic structure (use of octaves). Instead of using FM calls, these mice appear to invest in higher harmonics, possibly to address the problem of environmental clutter. Interestingly, these mice often even abandon their principal or main frequency altogether in favour of successive octaves.

Resonant space is required to produce such sounds. While the erect gaping posture of the Baiyomine mice is rarely observed in *Reithrodontomys mexicanus*, *Reithrodontomys mexicanus*'s sound picks up texture or is selectively dampened as it passes through nasal and pharyngeal cavities, modifying resonant properties and therefore the kind of harmonic sound that is produced. What we don't know yet is whether harmonic structure serves a particular function.

Another group of New World mice that produce stereotypic vocalizations are the grasshopper mice (*Onychomys*). These mice range from southwestern Canada to the southwestern United States. All the species in this group live in open habitat and dry conditions, ranging from mixed sand dune and oak scrub to mesquite areas. Throughout Texas, I studied this fascinating mouse in a number of habitats.

The name grasshopper mouse reflects the group's predacious habit. *Onychomys* mainly eats insects but may also consume small vertebrates. This mouse also claims the notoriety of successfully hunting scorpions. Stout and short-legged, it makes up in lateral manoeuvrability what it lacks in speed.

Its vocal repertoire includes signals used for close contact and for long distances. The loud-long call is most widely known and studied, and, as with *Scotinomys*, the carrier frequency—the frequency with the most energy—appears also to be the fundamental frequency or the principal frequency used by the mouse, and determined by the animal's vocal chords. Harmonics are muted or often absent except for the occasional single note at a high frequency. In fact, the carrier frequency is quite pure and very piercing—it can travel over relatively long distances. This is important given what we know about the ranging habits and more solitary lifestyle of this mouse: it makes its living in open, arid environments where habitat clutter is much less of an issue.

Still, harmonic structure is clearly present in early life. Infants and juveniles produce a variety of truncated calls, used to signal distress or irritation. It is unclear whether the

presence of harmonic structure is simply a reflection of physical immaturity, or a means to enable a parent to locate a lost infant mouse.

Superficially, *Onychomys* adults appear limited in the type and complexity of vocal signals they can produce, and these appear highly repetitive. Yet, other researchers as well as ourselves have observed more complex frequency modulation in *Onychomys*. Not always divided into discrete notes, these undulating waveforms are made purely in the ultrasonic range, inaudible to human hearing. We first recorded the modulated calls during a thunderstorm, and it is possible that the calls are provoked by conditions of stress or disturbance. Biologist Dr. Tommy Finley of the University of Arkansas at Little Rock has shown these FM calls to serve an important "close-contact" function, and they likely serve an important role in social behaviour.

Singing and Reproductive Behaviour

While environment is clearly important to the evolution of the songs of mice, reproductive behaviour may also have helped to shape vocalization. Given how easy it is to detect the location of the caller when vocalizations are frequency modulated, repetitive, or ongoing, there must be a significant benefit for the mice to offset the risks of increased predation and the metabolic expense involved in singing and song display (posturing).

In some species, but not all, singing is certainly important in courtship and mating. Different unique vocalizations for each species create a kind of label that can be important in isolating each species reproductively—preventing hybridization and non-viable matches between species by allowing quick and reliable species identification. In this way, acoustic behaviour can help maintain individual species boundaries.

The courtship ritual may encourage or alter vocalization. Singing is more frequently observed in *Scotinomys*, for example, during courtship. And *Onychomys* emits a highly muted version of its normal long call during courtship. In some antagonistic encounters, *Onychomys* may produce similar muted calls, which may be a possible indication of submission.

Obviously, it is an advantage to be able to identify the gender of a caller, to distinguish a competitor from a potential mate. Especially if an animal's lifestyle keeps it "travelling a lot," dimorphism, or gender differences, in vocal signals may help it more easily find a mate.

There are several explanations for the pronounced gender differences in vocal signals. For instance, increasing dimorphism can arise simply as a by-product of the speciation process—the process by which a new species branches off from an ancestral species. Groups or populations differentiate in behaviour to avoid conflict for space, resources, or even mates.

Gender differences in song can also arise through some form of physical constraint—such as larger body size housing a more powerful vocal apparatus. If such a relationship to size is "honest" (i.e., larger size indicating a fitter mouse), increasing dimorphism can help in the competition for mates by allowing a mouse to indicate its overall potential through its song. Lower fundamental frequencies generally correlate quite well to larger body size.

Females may therefore choose mates in part based on how well the potential suitor sings. An important element of this evaluation may be the "duty cycle" of a song, or the proportion of a song occupied by sound rather than the "dead-space" between note tours (repeated series) within a song. More duty and less dead-space would suggest a higher-quality mate. *Scotinomys* females, where there is dimorphism between male and female calls, may assess a suitor on the basis of his "duty cycle." But other mice may also evaluate song, though in a slightly different way—by judging how much energy is expended over a longer period of time, such as call rates through the course of a night.

The Importance of Life History

Development and life history of individuals provide important insights into vocal behaviour. Biologists know that disturbances in development can channel subsequent pathways for evolutionary change. This may be an important factor in why vocal elements that are active early in life disappear in some cases, while in others the original elements seem recognizable in the adult vocal repertoire.

No other adult mice repeat and modulate their vocal repertoire to the extent that the Baiomyine mice do. We have been able to identify the rudiments of the long call in infants as young as one week: short bursts of frequency modulated notes, which interrupt the otherwise long trains of loud and audible irritation and alarm peeps produced by infant mice.

Many calls of the infant repertoire generally disappear in adult mice, being emitted only occasionally during a heightened state of excitement, for instance, during copulation. But in all the mice presented here, aspects of the adult repertoire have a precursor from infancy to which they bear a striking similarity. And in the pygmy mice and *Scotinomys*, especially, these elements are retained throughout life, gaining energy and repetition as well as novel meanings.

The rapid development of Baiomyine infants may be an important factor in retaining the infant distress call as an active feature of adult acoustic behaviour.

New World mice enhance our understanding of the rich diversity in animal communication and foster an appreciation of its complexities. Ultimately, interpreting the evolution of acoustic characters will require a historical template—a family tree or "phylogeny" of species relationships. The tree serves as a point of reference upon which to hang every change that comes to characterize a species, including changes in behaviour. Using molecular sequence data, we are in the process of constructing such a tree, exploring a variety of DNA markers that hold promise for providing a backdrop to this rich acoustic tapestry.

In the best comparative tradition, this work will help us understand the evolutionary history of vocal behaviours and make sense of the influences that have moulded, and continue to mould, the songs of mice. ■

The Northern Snakehead: A Fish Out of Water

This bizarre introduced species poses a threat to native fishes in Canada and the US.

WESLEY BATES / 3 IN A BOX

IMAGINE YOU'RE WALKING beside an overgrown weedy pond and something moving in the grass catches your eye. Is it a snake? Surely, it couldn't be a fish! Yes, it's a snakehead fish.

Theoretically, this incident *could* happen. The northern snakehead (*Channa argus*) is one of several species of fish that have special chambers located behind and above the gills allowing them to breathe air, and have been known to

JULIANNE MAYO

wriggle across land in search of new water bodies. The species has received some media attention over the past few years as a worrisome aquatic invader that could out-compete native species.

What is this fish that can breathe air, wriggle across land, disrupt ecosystems, and has even been deemed the "Frankenfish" by some? Can it affect our backyard biodiversity?

Native to China, Korea, and Russia, the northern snakehead dwells in fresh

If northern snakeheads ever became established, it is likely they could successfully out-compete native predators here and disrupt the food chain, leading to a decrease in native biodiversity.

water and is highly tolerant of low-oxygen conditions. It has a snake-like body with a flattened head covered in large scales, a large mouth with canine-like teeth, and a rounded tail. The northern snakehead does not reach maturity until it is two years old and usually grows to almost 1 metre (3¼ feet) in length, although there have been reports of individuals as large as 1.5 metres (almost 5 feet). The fish is bred artificially in some areas to meet the growing demand for snakehead meat, which is used as a folk remedy in soups and wound-healing salves.

As early as 1997, specimens of northern snakehead were found in the United States, in Florida. But a big cause for concern for Canadians was the 2002 discovery of northern snakehead in Maryland. As a top-tier predator, the fish has the potential to disrupt native food chains by out-competing the naturally occurring top predators for food and space. Adult snakeheads are piscivorous, meaning that they eat other fish . . . and they are very good at it!

The original discovery of the northern snakehead in Maryland seemed confined to a single pond in Crofton. All fish were removed from the pond and additional measures were taken to stop the spread of the snakeheads via pond water overflow. When trying to prevent the spread of invasive aquatic species it is common to worry about people spreading the species overland from lake to lake. But since snakeheads can breathe air for up to three or four days and can wriggle across land, biologists also had the new task of preventing the fish's own overland migration.

A pond such as the one in Maryland is considered a contained water system and it is much easier to manage an invasion there than in an open river system. In October 2004, a northern snakehead was found in the Great Lakes, an open system in which an invasion would be difficult to control. Found in a Chicago harbour in Lake Michigan, the snakehead sighting raised alarm on both sides of the border. It turned out, however, that only one specimen was found and it was likely an aquarium release. This is an explicit example of why unwanted aquarium fish should never be dumped in the wild.

Throughout the summer and fall of 2004, the northern snakehead was also found in the Potomac River and its tributaries on both the Maryland and the Virginia sides of the river. A further cause for alarm in this particular case was the age of the fish that were caught: some were young and not sexually mature. Live-fish food markets tend to stock larger, mature specimens, suggesting that the immature specimens found in the river resulted from a reproducing population. This changed the status of the northern snakehead from "present" to "established"—a stern warning of how far this invasive species could spread in an open-water system.

Another impediment to controlling a northern snakehead invasion is this fish's apparent ability to thrive within a wide range of temperatures. In the establishment of an aquatic invasive species, temperature can act as a controlling force. The water temperature of an area, if it is higher or lower than the species' native range, can prevent reproduction or even survival of adults. The northern snakehead is one of only three snakehead species that live in a range from warm temperate to cold temperate water (0° to 30°C)—another reason biologists are so concerned about its invasive path.

Canadian waters, including the Great Lakes, represent a wide range of temperatures, most of which would not prevent the invasion of the northern snakehead. At this point, no northern snakeheads are known to have been found in Canadian waters. If the species is introduced here, however, Canadian waters are unlikely to contain any top predators (other than humans) that would keep its population in check. If northern snakeheads ever became established, it is likely they could successfully out-compete native predators here and disrupt the food chain.

The most likely source of the northern snakehead introductions in the US is live-food fish markets and aquarium releases; the fish have been found at multiple markets in the States and can be obtained through Internet sales. Recently, the ROM received two specimens of snakehead that were seized from an Ontario pet shop by a conservation officer. Neither was identified as northern snakehead. However, Erling Holm, an assistant curator in the Ichthyology Section of the ROM's Department of Natural History, identified one specimen as the bull's-eye snakehead (*Channa marulius*), a second species that could potentially survive Canadian waters. Holm identified the other specimen as a giant snakehead (*Channa micropeltes*), a species unable to survive our cold waters.

The presence of snakeheads in pet stores and live-food markets in Ontario is a serious cause for concern. We can learn from Maryland's experience and must understand that live releases of snakeheads can lead to a serious threat to our biodiversity.

Certainly, the northern snakehead is a fascinating species. It is not everyday that you learn about a fish that can breathe air and wriggle across land. We should appreciate and respect this remarkable creature, but at the same time we must appreciate and respect the remarkable threat it can pose outside its native waters.

Julianne Mayo is an ichthyology technician in the ROM's Department of Natural History.

A Rolling Stone

A fascinating fossil clam was found far from home.

Dear ROM:

Please find enclosed a CD with images of my fossil. This was one boulder, which was split with a hammer and chisel. It came from the Belleville area. It is natural limestone and has a bluish hue with browns and blues around the perimeter.

When the rock was split, it left one side convex and the other concave. They could be fitted back together. Combined they weigh about 200 to 250 pounds.

My family have been stone masons for 150 years and we have never seen anything like this. I have checked with other stone masons in Scotland and none of them recall seeing the like either. Today the young ones use diamond saws to cut stone so everything just gets lost in the cutting. I guess that is "progress."

I will wait to hear from you, and thank you for taking my call.

Agnes Pretty
Tottenham, Ontario

Above: Agnes Pretty's fossil clam.

Dear Ms Pretty,

Thank you for the CD of pictures of your fossil. It is a fine example of a fossil clam. Being so large—it is almost 15 cm (5¾ inches) across—it appears to belong to a distinctive Devonian species about 395 million years old called *Praecardium grandis*. The fossil has been preserved as an external cast and mould. Though the actual shell has long since disappeared, it left a concave impression in the rock, paired with the convex natural cast that replicates the outside of the original shell. This is a very common form of preservation, particularly for mollusc shells, which are often constructed of aragonite, a form of calcium carbonate that is unstable and dissolves readily when the animal dies and the shell is no longer protected by an organic outer layer.

JANET WADDINGTON

The group of clams to which *Praecardium* belongs is characteristically thin-shelled, so the resultant gap in the sediment where the shell once lay is not thick. The original presence of the fossil resulted in a very fine crack along which the rock broke when it was hit with the hammer. This is a common way to extract fossils. Indeed, rocks will often break naturally to reveal a fossil. Water seeps into the crack and then freezes, expanding the crack. The ice melts, more water seeps in and freezes again, and very gradually, over many freeze-thaw cycles, the crack

Above: *Praecardium grandis* from St. Mary's, Ontario, in the ROM's collection.

widens until the rock breaks apart. When nature is allowed to complete this process, the separation is often nearly perfect. If you try to help it along with hammer and chisel before the crack is well established, the rock will often break along other directions.

When we spoke on the phone, I told you that knowing where the fossil was from would give us a good place to start with identification. A quick look at a geological map indicates the age of the rocks that occur nearest the surface in the particular area, and so is usually a good indicator of the age of the rocks found there. This method starts to fall apart when the rock is not derived from local bedrock, but is a boulder such as yours. We call such boulders "erratics," meaning that they have been transported from elsewhere. They may be transported from a few to several hundred kilometres by glacial action, but even then there is usually some rock of approximately the same age occurring "upstream" (i.e., in the direction of glacial movement) from the boulder.

The rocks around Belleville, however, are Ordovician in age (about 455 million years old), and north of that area there are no Devonian-age rocks until you reach the James Bay Lowland, where the rocks are of a different lithology (rock type). As your fossil is in a boulder, it could be from just about anywhere. What surprised me, though, was to see a Devonian erratic so far from any Devonian bedrock. Similar specimens in the ROM collection—in rock that looks very similar—are from southwestern Ontario in the St. Mary's area.

When we spoke again, you thought the boulder could possibly have come from your property near Whitney. Whitney is on the Canadian Shield; the surrounding bedrock is about 1100 million years old—much too old for fossil clams. However, there is now geological evidence from rocks in the Kirkland Lake area confirming what has long been suspected: that the vast sea that deposited the Devonian-age sediments in southwestern Ontario once extended far to the north and must have left a fossil record there, which has subsequently eroded away. So, it is not outside the realm of possibility to find a Devonian erratic fossil out of the apparent direct line from any existing Devonian bedrock.

Paleontology often involves detective work. It is probable that your boulder did actually come from southwestern Ontario, possibly having been moved from there to where you found it by someone else—a human rather than natural intervention. Despite the uncertainty about its origins your fossil remains a fascinating relic of the past.

Janet Waddington is an assistant curator of Paleobiology in the ROM's Department of Natural History.

French Bisque: Beyond Soup

Though little information has been published on this fad porcelain, it remained popular for more than 150 years.

Dear ROM Answers,

I have included a set of photographs of a planter that has been in our family for a long time. There is no identification on the piece other than the numbers 3787. The piece is porcelain and measures 23 cm (9 inches) tall x 20.3 cm (8 inches) wide x 13.8 cm (5 inches) across the body. We also have an accompanying piece with a girl on the front in place of the boy.

Would you be able to determine the origins, age, and, if possible, a ballpark value for insurance purposes for this piece? Thanks for your time and consideration.

R. F. H.
Sault Ste. Marie, Ontario

967.288.4

Top: R. F. H.'s ornament/flower container, bisque porcelain with matte colours and gold. Probably German, model no. 3787, factory not identified, c. 1900. H. 23 cm (9 inches). **Bottom:** "Dancers," bisque porcelain figure. French, modelled by E. M. Falconet, Sèvres factory, c. 1760, ROM collection. Museum purchase. H. 12.6 cm (5 inches).

Dear Reader,

Judging from your photographs, your family heirlooms are a pair of bisque porcelain ornaments dating to around 1900. The name "bisque" refers to the first firing of a ceramic body. This initial firing dries out the body and usually shrinks it about 20 percent. In the process, the surface develops a matte texture. In most cases, the piece is then dipped in glaze, air-dried, and fired a second time to create a glossy, waterproof surface.

In the mid-1700s, potteries decided to make some items with a bisque finish. When this was done with porcelain, the body could look like marble or alabaster. The first factory to perfect the white bisque body was Sèvres in France, about 1750–1760. Consumers marvelled at the beautiful white body, which established a reputation for bisque, or biscuit, porcelain. Figures were used as ornaments and table centerpieces, clocks, and other furniture. Other factories copied Sèvres with varying degrees of success, but the reputation of French bisque remained intact until the early 1900s.

In the period c. 1875–1910, a wide range of decorator wares were marketed as French bisque. Most of them tended to follow ornate, overly sweet, and sentimental subject matter and forms. Fancy dress or costume events were very popular at the time and this was reflected in the figures. Pairs of figures in historic dress for the mantelpiece, where one is wearing elaborate male clothing and the other, female clothing, are common, though each figure looks very effeminate and androgynous. You almost can't tell the sexes apart.

In your case, the toque, the open shirt with a bandana tied in a bow at the neck, the sash at the waist, and the fish net suggest that your figure was patterned after some kind of Neapolitan fisherboy, a theme

PETER KAELLGREN

BRIAN BOYLE, ROM

Top: Porcelain figure. English, Derby Porcelain Works, c. 1794, ROM collection. Gift of Mrs. A. Murray Vaughan in memory of her mother, Mrs. Howard W. Pillow (Lucille E. Pillow). H. 34.3 cm (13 1/2 inches). **Bottom:** Reverse side.

978.189.36

that was popular with artists and sculptors in the late 1800s when Italians in regional costumes were considered extremely appealing. The oversized flowers are pure Victorian fantasy.

By 1900, excessively Art Nouveau fantasy pieces such as your ornaments were commonly produced. Notice the swirling lines, floral and plant motifs, and asymmetry that characterize Art Nouveau. Manufacturers were no longer content with the simple elegance of a matte white surface. They tinted pieces with matte pastel colours, touches of brassy gold, and sometimes bits of glossy, pearlized glaze. Such pieces with impressed model or production numbers were produced by factories in Germany, probably mostly in Thuringia, where there was a skilled labour force. We don't know much about the factories because trademarks were not consistently applied to most of their products, though some may have had paper labels, which have long since been cleaned off. Factory names don't seem to appear in advertisements. This is understandable because it was better marketing to pass this German porcelain off as French. Such "French bisque" retailed at affordable prices in North America. It was not the most expensive or most fashionable ware, but it certainly was popular.

Note that your ornaments are undecorated on the back. Ceramic ornaments of the highest quality, made for the more expensive market, tended to be painted on the backs so that they would look attractive if placed in front of a mirror over the mantel or on a mirrored shelf. The homes of the rich had many mirrors both over mantelpieces and installed in furniture.

There are no books on these late bisque figures, probably because so little information has been discovered and a solid collecting market has yet to develop. Most pieces of this type tend to be valued below the standard deductible amount on a household insurance policy.

By way of comparison, it can be interesting to look at your ornament against historic examples from the ROM collection. One of the treasures of the Museum collection is a set of four small figures in Sèvres bisque showing pairs of children in fancy dress performing a variety of regional European dances. Dating to around 1760, three of these figures were modelled by the sculptor Etienne-Maurice Falconet (1716–1791), who worked for the factory between 1757 and 1767. Judging from their size, about 13 cm (5 inches) tall, these figures were probably designed to be used as part of a table centrepiece. Traditionally, these had been made from sugar, almond paste, and other confections, but by 1760, small and re-usable porcelain figures were becoming fashionable. In many cases, the sculpture for the table centrepiece was symbolic and drawn from stories in literature or popular theatre. These Sèvres figures were likely inspired by the troupes of child actors, dancers, and entertainers that were travelling the circuit in Europe around 1760.

Although many porcelain factories on the Continent attempted to imitate Sèvres bisque, the most successful was the Derby Factory in England, which in 1769 acquired the fa-

mous Chelsea factory. In 1978, the ROM received a collection of bisque figures through the generosity of the late Mrs. A. Murray Vaughan. The collection was assembled by her mother, Lucille E. Pillow, whose collection of English bisque porcelain from the late 1700s and early 1800s is one of the finest in the world.

By the 1790s, the Derby Porcelain Works in England had perfected their bisque body so that it was just as much admired as that of Sèvres. The style of porcelain had also changed under the influence of the Adam Brothers and Neoclassicism. Figures tended to be more realistic, well modelled, and refined. One of the masterpieces of this period is a "Shepherd" modelled by the Swiss sculptor J. J. Spängler about 1794. Although shown in contemporary dress, the pose of the male figure derives from a piece of ancient Classical sculpture. At 34.3 cm (13 ½ inches) tall, this is a commanding piece of serious sculpture.

After 1800, the quality of bisque porcelain became less consistent. In England, about 1850, it was displaced by Parian porcelain, a somewhat more waxy, white ceramic body that closely resembles marble. Parian porcelain is a topic on its own for another column. Continental factories continued to make bisque porcelain, mostly for novelty and decorator wares, though sometimes for serious sculpture in the Classical tradition. The ROM collection includes examples of the range of bisque porcelain that was available in Canada around 1900; it was often used to decorate Victorian and Edwardian parlours.

983.175.38

Hanging wall plaque, allegorical figure, slip-cast, press-moulded, and hand-worked bisque porcelain with green slip decoration. German, Älteste Volkstedter Porzellanfabrik, Thuringia, c. 1891–1910, ROM collection. J. S. Garth Tassie Collection. H. 35 cm (13 3/4 inches).

Typical of the period is a porcelain wall plaque made by the Älteste Volkstedter Porzellanfabrik of Volstedt in Thuringia. It is marked "Germany" on the back, indicating that it was made after 1891 when British and US customs regulations required imported goods to be marked with the country of origin. It also is marked with the impressed model or production numbers "6760" and "10." It is an impressive example of a line of German bisque porcelain that was extremely popular in Canada. It resembles Wedgwood jasper ware; however, the ground colour was created by covering the white, slip-cast body with a thin coating of coloured clay—sage green and pale blue being the most popular colours. In this case the allegorical figures of the classical lady pelting the putti (small boys) with roses were pressed in a separate mould and applied to the surface, with the roses individually hand-modelled. This plaque is larger and more elaborate than most objects of this type. Smaller plaques, ashtrays, vases, boxes, trays, and other pieces tended to have the white parts modelled in relief as part of the mould for the piece, and the colour selectively applied to the background. Popular decorative motifs included ladies and flowers, views of tourist destinations, such as Niagara Falls and the Chateau Frontenac, and replicas of popular, moralistic, Victorian paintings, such as *The Angelus* and *The Gleaners* by Jean François Millet (1814–1875).

Thank you for sharing your bisque porcelain ornaments with our readers. In conjunction with period examples from the ROM collection, they help to provide insights into decorator ceramics that were popular in Canada at the turn of the last century.

Peter Kaellgren is curator of European Decorative Arts in the ROM's Department of World Cultures.

BRIAN BOYLE, ROM

WE'D LIKE TO HEAR FROM YOU

If you own furniture, silver, glass, metalwork, ceramics, textiles, or small decorative objects that may have an interesting past and have aroused your curiosity, this column is for you. Send a clear colour photograph (or 35-mm colour slide) of the object against a simple background, providing dimensions, a description, any markings, or any known details of its history to: ROM Answers, c/o *Rotunda* magazine, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6. Be sure to enclose a stamped, self-addressed envelope large enough to include any photos that must be returned to you.

Neither *Rotunda* nor the author nor any other person who may be consulted assumes any legal responsibility for these opinions or their ramifications. No financial appraisals will be offered.

Letters will be acknowledged as staff time permits.

ROM Original

The ground-floor galleries of 1912 were graceful, light-filled spaces. In late 2005, their original grandeur will be restored.

ROM ARCHIVES

JULIA MATTHEWS

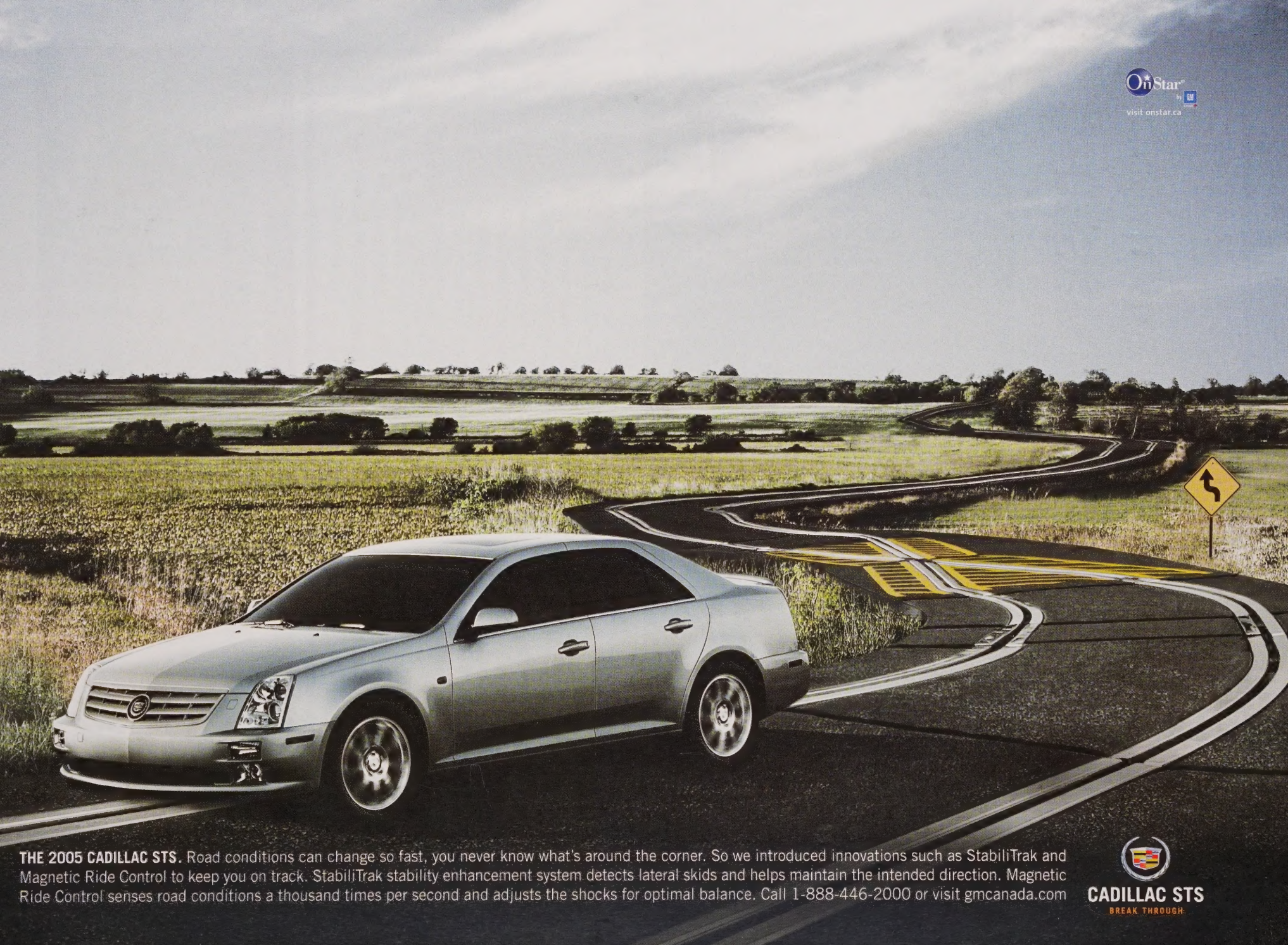
Since this will be my last From the Archives column, it seemed appropriate to commission a new image from our photographer, Brian Boyle, whose work graces this magazine each month.

The space you see in the above photograph would have been the ground-floor galleries in 1912 when visitors were first admitted to the ROM. By 1928, the galleries were purposely crammed so tight with artifacts that taxpayers would be unable to move freely and would join with ROM staff to urge expansion. I know that there was office space on this floor. I was surprised that I could find no guidebooks, floor plans, or reports to tell me exactly what was on display at the beginning.

Instead, I called upon the notes that were prepared for the Governor General when he came to open the building officially in 1914. In the central hall there were arms and armour together with wooden altarpieces. There were small cases with brass, silver, fans, and majolica—"from Egyptian times down through Roman and Persian to the great development in Spain and Italy at the time of the Renaissance." There was glass, plus European furniture, including an Elizabethan Room. There was also a lace and embroidery room. Next was "a gallery of great beauty . . . formed by massing together a large collection of Chinese porcelains." Then, a Japanese gallery "with potteries, armour, lacquers, and metalwork . . . which has never been excelled."

When this ground-floor space reopens in December, it will have regained its original splendour, with open windows and a long vista—and even some of the same artifacts will once more be on display.

Julia Matthews is head of the ROM's Library and Archives.



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